

**DIGITAL VERSION**

**BLOCKBUSTER REPLACEMENTS**  
Online film rental services reviewed and rated



# COMPUTER SHOPPER

**18-PAGE  
WINDOWS 10  
SPECIAL**  
Every feature  
explained

# Windows 10 the guide



**PLUS!**

**DJI Phantom 3**  
The affordable 4K drone

**Photoshop VS Lightroom VS Elements**  
Photo-editing showdown: which package is best for you?

**bPay VS Apple Pay**  
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# Welcome!



**YOU MAY HAVE** heard, but a little thing called Windows 10 has arrived. This is a big deal for Microsoft, and not just because it's desperate to win back consumers' trust after the unpopular Windows 8.

Windows 10 is different from previous versions in a number of ways. It's the first version of Windows to be given away as a free upgrade, as well as the 'last' version; Microsoft has said that, from now on, new editions of the operating system will arrive as transparently as updates to your web browser.

It's also the first version of Windows to work properly across desktops, laptops, hybrids and tablets and, of course, it has a Start menu. We've been testing Windows 10 over the past few months to become familiar with all its features and quirks, and in this month's *Shopper* we've combined our knowledge to bring you the ultimate guide to the new operating system. Whether you've already installed Windows 10 or are yet to take the plunge, starting on page 92 we'll show you everything you need to know, from upgrading and installing to using all the best new features.

Ever since relentless increases in clock speeds came to a screeching halt with the cancelled 4GHz Pentium 4, we've worried about the limits of silicon as a basis for our processors. Experts now predict that we have only a handful of years left before we can't squeeze any more computing power out of our beloved wafers. But what material should form the basis of the new generation of computers? Should it be optical, chemical, biological or something else? Join us for some future-gazing on page 110, as we journey beyond silicon.

We all love a good film, but one of the bugbears among the *Shopper* staff is just how difficult it is to rent a movie now most video shops have ceased to exist. There are online rental services aplenty, but they all differ in terms of video quality, the hardware you need and the selection of available titles. The market is a baffling mess, which is why we've decided to work out once and for all what film and TV services actually offer, and at what price. Crack out the overpriced popcorn and the oversized Pepsi and get stuck into our online film and TV services group test, starting on page 78.

**Chris Finnamore, Editor**  
chris@computershopper.co.uk

MEET  
THE  
TEAM

## QUESTION OF THE MONTH

Once you've installed Windows 10, what's the first thing you'll ask Cortana?



**Chris Finnamore**

“How does it feel to go from helping the Master Chief save the galaxy to answering endless questions about burritos?”



**David Ludlow**

“How do I deactivate you permanently?”



**Katharine Byrne**

“Who are you, and what have you done with Windows 7?”



**Michael Passingham**

“What in the blazes is a Bing?”



**Seth Barton**

“Are you just Clippy under a mask like in Scooby Doo?”



**Tom Morgan**

“Where can I find an anger management class to help me deal with Windows 10's charming 'quirks'?”



**Richard Easton**

Would you rather fight one horse-sized Steve Ballmer or 100 Steve Ballmer-sized horses?”

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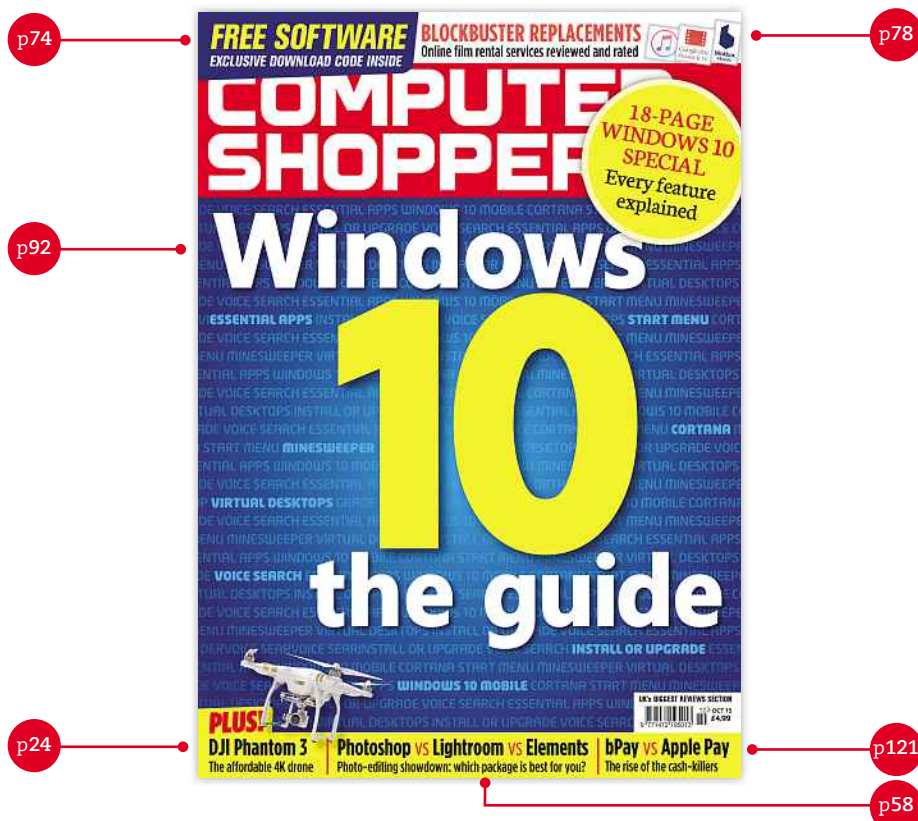
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OR SEE PAGE 126**



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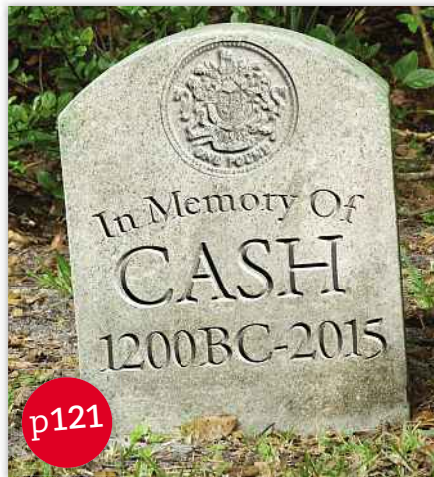
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## 74 Your software\*

Organise, edit and share all your digital images with PhotoDirector, CyberLink's comprehensive and easy-to-use suite of photography tools



\* FREE SOFTWARE EDITION ONLY

# Letters

It's a mixed bag of correspondence this month, as we're praised for our software giveaways and video coverage, but get it in the neck for printing irresponsible illustrations, fewer reviews and being too nice to Microsoft

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### RARE NON-USELESS PANDA

My experience of the *Computer Shopper* Panda Internet Security 2015 trial has been intriguing. First of all, with the AV signatures in the cloud, the laptop I use most for the internet sped up immediately and now boots up in a few moments. I can hardly believe it. Curiously, when the Panda ad appears asking me to fork out for the paid edition – which I'm tempted to do – the number of viruses stopped is listed as zero. Zilch. A big 0. Why do you think this might be? The laptop hasn't ground to a halt loaded down with unintercepted viruses. I'm on Virgin Broadband, so could it be that Virgin is already good at blocking the bad guys?

For those of us who shoot video, I'm pleased to say that *Computer Shopper* is a valuable and comprehensive guide to hardware and everything relating to computing. I have to single out Ben Pitt for particular praise in this respect, with his authoritative coverage of video production. It could be time to start subscribing.

Philip Fowler

Thank you for your kind words, which we've passed on to Ben. Regarding Panda, it's not unusual to have no viruses intercepted. If you run a firewall on your router, your Windows system is up to date and you haven't clicked on any dodgy email attachments, a virus is unlikely to get as far as your security suite.



⬆ Your AV software may not find any viruses if you're careful and you keep everything updated

### SAFETY FIRST

I just received my September issue of *Computer Shopper*, and I was surprised to see an image of a guy using a feather duster and a liquid spray to clean the inside of a PC ('Spring clean for Windows 10', *Shopper* 331). I understand that the image is intended to be humorous but, in our compensation culture, I feel you leave yourself open to claims when someone tries this for real on their PC while it's switched on (your picture shows a light inside the PC, intended to appear as a sparkling glint but easily construed as a power indicator).

Anyone with any common sense knows that you're only trying to convey an idea, but our nanny state allows the public to plead total ignorance when they make claims.

Gil Fleming

Yes. Never use a liquid spray and a feather duster to clean the inside of a PC, running or otherwise.

### POWER NETWORKING

Something that has occurred to me many times about networking over power lines is that we're rarely given any indication of compatibility between devices.

I understand that there are different chipsets with different compatibilities, and I'd like to see a comparison between the brands that states what the chipset is and what it should be compatible with. For example, I've been using the Devolo AV200+ and have added an AV500+. They're compatible and seem generally reliable, but some devices just don't seem to handle Wake On Lan (WOL) correctly if at all, and browsing other resources such as a shared drive or printing (one of my biggest bugbears) can be a problem.

Ideally I'd like to see a list of known brands such as Devolo, TP-Link and so on that states which are compatible with which



⬆ Powerline networking is great, but it can cause problems with printers

and whether they work with WOL, printing, shared drive browsing and so on. This would be useful for many households and perhaps small businesses too.

Paul Winstone

Powerline networking devices that support the same standards (such as HomePlug AV) should work well with each other, but we agree that they can be problematic when using network printers. We'll look into this in a future issue.

### GOING STRAIGHT

I just want to concur with Chris Finnamore regarding his rant on buying HD video legitimately from online suppliers (*Rants and Raves*, *Shopper* 331). I had exactly the same experience (and thoughts) last month when I wanted to watch two great sci-fi movies: *Interstellar* and *Ex Machina*. I do love my sci-fi so I had a look at which services were streaming and eventually plumped for Amazon after discounting Sky because it didn't offer HD.

After starting to watch *Ex-Machina* the picture started to rescale periodically, which was pretty distracting. I became convinced that Amazon had streamed the SD version (or was switching), and this seemed to be borne out by the fact that in the end I was charged the SD rate despite being originally billed for HD.

I thought this might be a one off, so I watched *Interstellar* on my bigger screen and,




although the picture quality was good with only one re-scaling incident, I still felt it didn't 'pop' in the same way other HD content I've seen has done. A bit of research suggests that HD streams from Amazon and the like are not 1080 but 720, which was a surprise. If Blockbuster were still around I'm sure I could have rented the Blu-ray for £4.50 or so.

I'm still not clear as to whether this is a limitation of Silverlight or the rights given to online streaming companies, but you'd think they would have learned from the mistakes of the music industry. If this is true it harks back to the days of those annoying FACT commercials (and copyright warnings at the end of programmes that can't be skipped) on legitimately purchased DVDs. As Chris points out, we want to support the film and music industries but the distributors and rights holders make it incredibly frustrating.

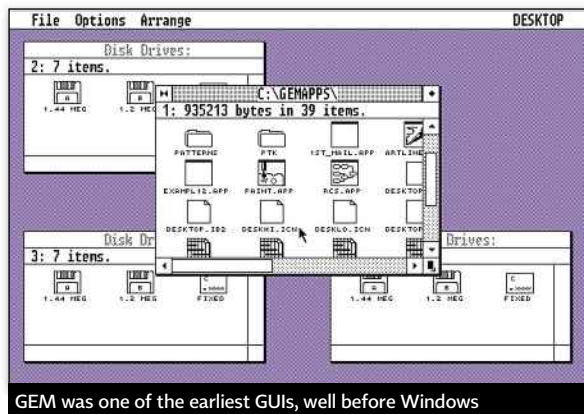
Stuart Mitchell

We completely agree. As shown by our group test on page 78, the whole thing is a mess, with few services nailing down what 'HD' actually means. If you really care about quality the only way is to buy films on Blu-ray – which may well be just what the film studios want.

#### HIDDEN GEM

 In your article 'OS explained' (Shopper 330) you refer to "the introduction of the graphical user interface (GUI) to the world of PCs with the first version of Windows in 1985".

This distorts the facts somewhat in favour of Bill Gates. I remember using a GUI that was superior to the early Windows versions (until, arguably, Windows 3.1) and had been



released for the PC months before Windows v1. This was Digital Research's GEM system.

I believe there were also other GUIs for PCs that predate Bill Gates' version, but Microsoft has tried to rewrite history to suggest that before Microsoft there was nothing – as your article seems to do. A little less of the "Microsoft is perfect" please!

Colin Reeves


Mike Bedford, the feature's author, replies:

"I'm well familiar with Digital Research's GEM, having used it myself several years ago, and I remember having to switch back and forth between GEM and Windows depending on which application I was using. The sentence you quote, while seeming to ignore the existence of GEM, was in fact made in the context of an operating system, while Digital Research never referred to GEM as such. Admittedly, GEM was similar to early versions of Windows in that it was a GUI front-end that relied on the underlying MS-DOS operating system, but our aim was to cover systems that most people considered operating systems, rather than getting too involved in the fine details.

Regarding your final comment, we'd never suggest that anything is perfect. Indeed, you'll have noticed that we did discuss several non-Microsoft operating systems. Despite

giving Professor Timothy Roscoe, an OS expert, the opportunity to provide a critical comparison of operating systems, his suggestion that there's not a lot to choose between different operating systems because they share a common ancestry was, perhaps, unexpected. Certainly it doesn't paint a picture of Microsoft as perfect, but on the other hand it doesn't altogether support the views put forward by Microsoft's critics."

#### BAD REVIEW

 You used to have several group tests per issue, but now it seems to be just one – and this time it's routers, with many of the star ratings missing from both the text and table. Just how many readers do you think will actually go out and buy a new router on a regular basis? Not many who aren't in business or commercial environment, I suspect, and I didn't think *Computer Shopper* was a business magazine.

Then we have the 'don't install Windows 10' feature, which is actually a 'do install Windows 10' feature because we've decided that Microsoft has suddenly stopped being the monopolistic mega corporation we've been telling you it was for the past 15 years, and is now amazing in every way.


Finally, there are just 109 reviews this month. Is this the lowest number for the past 10 years? I'll guess it probably is, and my review is that this issue gets only two stars. Just. Sorry guys, please raise your game and give us back the excellence we used to enjoy.

David Hoults

We're sorry you didn't like the issue. We have gone down to one group test per *Shopper* as there simply aren't as many products out

## ★ Star letter

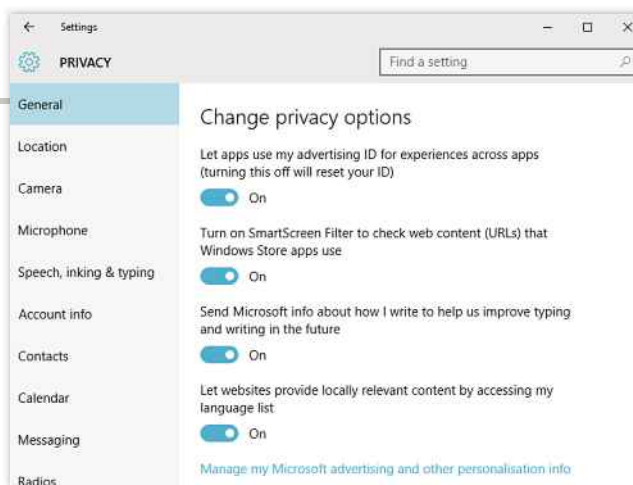
#### WINDOW SPY

 I've been using Windows 10 Preview for some time and I like its speed and ease of use. One unwelcome change from Windows 7, however, is the intrusive nature of the privacy settings. By default the program has access to your webcam, microphone, location and spelling/inking. The excuse is that it provides a better experience (targeted advertising?). Apps can also access your mail, contacts and calendar by default.

To me this is intrusive and amounts to spying. I had to switch off 10 settings to secure my privacy. I think more people should be aware of this and, ideally, we should be asked to opt in to who can access information on our PCs rather than having to opt out.

Harry Sequence

We like to think there's a more innocent reason for these permissions. If apps are allowed to access functions such as your webcam and microphone in advance, programs such as Skype will work correctly straight away. Spelling and Inking are apparently used by Cortana to "make better suggestions for you".



↑ You can change Microsoft's default privacy settings


However, we agree that anything you type into Cortana, just as anything you type into Bing or Google, could be used for targeted advertising. It would probably be best if apps asked for permissions when needed, rather than making you agree to them wholesale.

there as there used to be. For example, Samsung and Sony no longer sell laptops in the UK, and other manufacturers don't refresh their product lines as often, so this has reduced how often we can run laptop group tests. Another example is components: there are fewer motherboard manufacturers selling in the UK and fewer chipsets, and many graphics cards are based on reference designs, making them almost identical. This is why we now review components in a bumper issue once a year, when enough manufacturers have released new kit to make the group test interesting.

Wireless networking, on the other hand, is a fast-moving technology that's improving in leaps and bounds, and fast wireless speeds are essential if you want to stream TV or films from the internet to laptops and tablets. The reason five of the routers didn't have star ratings is because they're provided with a broadband contact and can't be bought in isolation, so they're not directly comparable to the rest of the models in the test.

Instead of multiple group tests, we now have up to seven features in an issue, covering the increasingly wide spectrum of computing as it moves beyond the desktop to mobile devices and into the cloud. We feel this increased feature coverage makes up for having fewer group tests. *Computer Shopper* still has around 50 pages of review content, which we feel is substantial.

### WINDOWS OMEGA


 In the old days, when a PC became slow and you'd tried all the usual things to get it back up to speed, the only remedy was to perform a clean install using your system disks. With Windows 10 this may not be possible after the initial upgrade as you won't have the disks. What do you suggest in these circumstances?

Even if you have Windows 10 disks, after its continual upgrades and alterations to the OS, will you be able to do a clean install?

Richard Rudd

This is still a bit of a mystery, as Microsoft saying "Windows 10 is the last version" is easier than explaining how it's actually going to work. Our preference would be for the latest Windows build to be available to download as an ISO disc image, which you could then burn to DVD or put on a USB drive for a reinstall.


### A FAIR COMPARISON?

 In *Shopper 331* you carried out a group test of routers from various manufacturers that was very similar to a group test you published some months ago entitled "Bin your ISP router" (*Shopper 323*). In my opinion it would have been more instructive to cross-reference these tests, as many of the routers reviewed in the earlier feature seem to be current models that are still on sale at various outlets. For example two Asus routers, the DSL-AC68U and RT-AC87U, received glowing reviews in the earlier test, but the Asus RT-AC3200 that featured in the latest test received a mixed review.

I know the latest Asus model is a tri-band router so strictly speaking it's not comparable to the earlier Asus models, but the TP-Link Archer C9, which received a Best Buy award in the more recent test, would seem to be very similar specification-wise.

Do you feel it's fair to compare and contrast these devices as I have suggested or is it the case that, with rapidly evolving technology, one buys the latest model today and it is already obsolete by the time the next version is working its way through the system?

Richard Najdich

The wireless tests we use to test routers have remained the same between this group test and the last, so the results printed on the graphs page will be directly comparable. User interfaces and features tend to improve over time, however. The reviews will tell you all you need to know. 

## WRITE IN AND WIN

Do you wish your computer was faster when booting and loading applications? Thanks to Crucial, you can achieve your dream of a faster PC or laptop with the BX100 SSD. The writer of our Star Letter will be awarded one of these solid-state devices, which can be installed in a desktop PC or a laptop.

This fast SSD is 15x faster than a hard disk, and will make your computer boot incredibly quickly and make applications faster to load. With 500GB of storage, there's plenty of room for Windows and all your applications, too.



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### PLUS

We're offering every reader who has a letter published and supplies their address a *Computer Shopper* 'Ranter' or 'Raver' mug.



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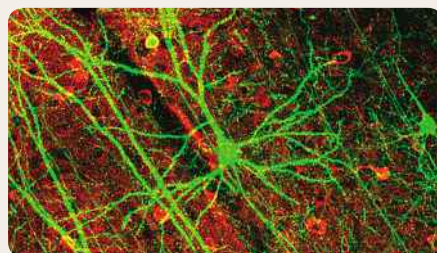
### › WINDOWS 10 PCs

If you've been holding off buying a new PC until Windows 10 was released, now's the time to buy. We round up 10 of the best new desktop computers, all pre-installed with the latest OS. With prices starting at £600, you'll be able to get something today that will last you for years.



### › ANALOGUE COMPUTING

All computers are digital and will be forever, right? Think again, as analogue computing might be making a comeback. By mimicking the human brain and unlocking a torrent of computational power, this supposedly obsolete technology could be the future. We find out how it works and how far away we are from real analogue computers.



### › INTEL SKYLAKE

After its massively delayed Broadwell desktop processor failed to impress, can Intel's Skylake make the difference?

### › MAKE YOUR PC SILENT

A smart fan controller will keep your PC cool and quiet. We show you how to build your own with the open-source Arduino platform.



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# Easy as Pi?

It's meant to be simple to set up, but **David Robinson** finds that the Raspberry Pi is far from child's play when it comes to installing Python



**DAVID ROBINSON**  
Software and systems developer  
letters@computershopper.co.uk

**"GRANDAD, CAN YOU** use a Raspberry Pi as a detector?"  
"Yes – detecting what?"  
"Intruders."

Grandson Aidan has reached the age where boys move on from breaking stuff and taking things apart to wanting to build things that work. He's been playing with a 200-in-1 electronic projects kit and made a detector that's triggered when somebody interrupts a light beam from a torch falling on a CCD light detector. Crude, but it works. Now he fancies making something more sophisticated.

I have two Pis languishing on a shelf and gathering dust. One's a model B that's about two years old, and there's also a new Pi model 2 purchased a few months back, but unused due to too many other things to do. For the uninitiated, a Pi comes with a series of connectors, known as GPIO (General Purpose Input Output) pins, which can be used to connect the Pi to things such as sensors, relays, switches and so on. This makes the Pi popular with inventor types. You can also use a Pi as an effective controller and as a means to collect data for monitoring and analysis. For these reasons, Aidan's curiosity

stands for 'New Out Of Box Software'. Good job they didn't call it Basic rather than New.

One of the things I love about the Pi architecture is that you can have loads of variants of computer type just as a result of booting from a different SD card configured in a different way and, if you make a mistake and trash the whole OS, setting up another card is quick and easy. NOOBS offers several flavours of Linux on top of Raspbian, including the once highly esteemed RISC OS.

## MOUNTING PYTHON

I opted for Raspbian, and the installation went swimmingly. Next up was installing the GPIO module that allows the Python language to talk to the Input Output system. The logical way to find the right download was to Google it. The first search result was a Wikipedia description of GPIO, followed by a list for the Pi. The second and third results were descriptions of Pi-specific hardware, then a YouTube tutorial, then finally a link to [www.python.org](http://www.python.org) with a download button that gets you the snappily named RPi.GPIO-0.5.11.tar.gz file. This pot of gold was a compressed file containing all the files relating to the Python extension.

Under Linux you install stuff like this from a terminal window. I started by 'untar-ing' the downloaded file, which unpacked a load more files including one called setup.py that contained all the instructions to set up the GPIO module. I typed in 'python setup.py install' and, whoopee, it installed. But only sort of. Somewhere in the stream of progress information lurked an error message saying the script couldn't find a C language header file. After firing up Python I asked it to show me the add-on modules it had installed, and the list included RPi.GPIO version 0.5.11. Great. I then tried to access the GPIO module and Python said it wasn't installed.

It seemed that my hovercraft was full of eels. Confused? Google it.

## TOODLE PIP

More searching revealed an alternative approach. To be sure I reinstalled NOOBS and Raspbian to make sure the system was pristine, then tried typing 'pip install RPi.GPIO-0.5.11'. This set off another train of automated downloading and reams of status info, after which Python still insisted that RPi.GPIO was both installed and not accessible because it wasn't installed. Argh!

Windows 8 looks like less of a disaster by the minute. Further internet digging revealed that the RPi.GPIO module is pre-loaded into Python on the latest version of Raspbian. Well, that's nice to know. There's no reference to this when you download and set up the operating system. If you Google 'Raspbian Python change history' the first reference points to [www.raspberrypi.org/documentation/usage/python/more.md](http://www.raspberrypi.org/documentation/usage/python/more.md), where there's a screed about the relative merits of Python 3 versus Python 2, along with a specific instruction to install RPi.GPIO the way I did. And doing that breaks your Python installation every time. I know because I tried it, yet again, with a fresh run of NOOBS.

OK, so I wasted a few hours, nobody died, the world didn't come to an end and eventually I sussed out the right way to do it. What concerns me more is that if Aidan had been doing this on his own, he'd have likely come to the conclusion that it was all too much effort and gone back to playing Grand Theft Auto on the PlayStation. As it is, we now have a Pi that can detect when somebody triggers the system, turns on a flashing LED and screams, "Get out of here scumbag!" in a frightening bass voice through an amplified speaker. His sister is not amused. The question now remains: what shall we do next?

If Aidan had been doing this on his own, he'd have concluded that it was all too much effort

presents a great opportunity for some education by stealth.

I had an SD card configured with the Raspbian OS for the Pi B, but had to start from scratch with the model 2 thanks to its microSD card slot. The method of getting a bootable operating system from a Pi on to a memory card has changed since I last did it. Now you simply download a Zip file from [raspberrypi.org](http://raspberrypi.org) and copy the contents to the card. They call the operating system install system NOOBS, which



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# Pharming today

A Shopper reader highlights the issue of 'router pharming', where cybercriminals can change a router's DNS settings to enable remote hacking. **Gordon Holmes** investigates



## GORDON HOLMES

With more than 30 years of experience in law enforcement, our retired cop gives a police officer's perspective on the sticky subject of cybercrime  
letters@computershopper.co.uk

**THERE ARE TIMES** when, thanks to the constant stream of data breaches and cyberattacks on large corporations, the subject of my monthly column suggests itself. There are other times when a subject highlighted by you, dear reader, deserves a public airing. This month's column belongs in the latter category, and I'm grateful to Bob Walker from Epsom for sharing his experience of a kind of attack that I knew was happening but had not taken the time to fully consider the implications.

The subject of router hacking, also known as router pharming, has sat on the fringes of security discussions in recent years. However, a number of incidents (including Bob's) are pushing it to the front of the queue. In effect, there would appear to be a large number of small office/home office (SoHo) routers that are susceptible to remote hacking, allowing attackers to alter the DNS configuration of the router concerned and so redirect traffic to malicious DNS servers controlled by criminals.

This topic has been around since 2011, but gained attention

that has an authenticated cookie on their machine. A visit to a website that's been infected with a drive-by download results in malicious JavaScript being introduced to a machine on your network that, in turn, forces your router to change its DNS settings. The attack is effectively from the inside of your network.

## HARVEST FESTIVAL

So what could the bad guys do if your router fell victim to the attack? This type of compromise is effectively a man-in-the-middle attack that can intercept all your traffic, harvesting passwords, bank details and all the sensitive information involved when using any form on the web. It could also redirect your page requests to any malicious website, by substituting the site's correct IP address with a criminal one.

An example of this occurred in Poland recently where, in a fairly localised geographical area, a large number of routers were compromised and their DNS settings altered to make them redirect page requests to criminal DNS servers. These servers then directed most requests to OpenDNS servers, making the legitimate sites load correctly. However, requests made to banking sites were identified and redirected to phishing sites, where login credentials were intercepted and funds stolen. The losses were substantial.

It would appear the routers affected were at the budget end of the market, supplied by ISPs to customers in certain countries, with Brazil and India being at the top of the nations affected. The kit supplied by the big ISPs in the UK has not been mentioned as being especially vulnerable, certainly in the research I have conducted. Some commentators state that enterprise-level routers are more effective in combating these sort of attacks due to their greater built-in security, but there is no evidence to support this.

I am being careful about not mentioning any particular router manufacturer. If you are concerned about this issue, I would encourage you to do your own research to identify if your router has been found to have security vulnerabilities. Googling 'SoHo pharming' or 'router hacks' will turn up results.

## TEAM SPIRIT

I have also contacted Team Cymru to see if there is any update to their original research. Kevin Williams, general manager of TC-UK Internet Security, said: "Often when a customer receives a new router it can be set up with default passwords; this is more common with older routers. Miscreants can either access your router by simply using that default factory-set password found in online manuals, by password-guessing, or by using a brute-force attack, using multiple regularly used words and phrases to identify the password to the router.

"Another tool used is malware such as DNS Changer, distributed as a drive-by download when visiting a compromised website. There are also some routers that have really poor software (firmware), and these have built-in vulnerabilities that miscreants scan for and abuse."

So there we have it. As we all become more security-savvy in protecting our various machines, be they mobile or laptop, the bad guys' attacks evolve and find another path of least resistance. You should identify and update router firmware, disable remote administration features and change the default password on your router – and regularly check your DNS settings.

• Readers worried about DNS router attacks can secure their network using a second router, following a guide by Head of Dennis Technology Labs Simon Edwards. See [tinyurl.com/dnshackprevention](http://tinyurl.com/dnshackprevention) for more. **CS**

This type of compromise is effectively a man-in-the-middle attack that can intercept all your traffic

with the publication of research by the respected security team at Team Cymru ([tinyurl.com/cymrupharming](http://tinyurl.com/cymrupharming)). The team found that around 300,000 unique IP addresses had attempted to connect to two malicious DNS servers over a one-week period.

How do these attacks take place? The main point of compromise uses cross-site request forgery techniques (CSRF), which exploit the trust a website has that it is dealing with a known user, for example one







# RANTS & RAVES

The past is now officially the future, as humanity rediscovers Victorian tech, chairs are abandoned for feet and faces come to resemble those of our amoeba ancestors

*Mel Croucher*

## RAVES

Nikola Tesla's promise of abundant wireless power could soon come to fruition thanks to some bright spark in Seattle

**NIKOLA TESLA WAS** born in Croatia in 1856, he died in New York in 1943 and he had a complex sex life and a great moustache. It was in the summer of 1900 that Tesla figured out two amazing things. First, he proved that natural frequencies could be used to transmit data, text, speech and images through the air. And second, he realised that these wireless signals can be harnessed to produce limitless free energy. Obviously, the oil barons, energy companies and governments of the day thought this was a really bad idea because they couldn't meter it, sell it or tax it. So they stymied old Nik, who died in poverty, and we've been suffering ever since. Until now, that is.

I'd like to propose that the Nobel Prize for Physics and a Blue Peter Badge are immediately awarded to someone who has turned Tesla's dream into reality. This bespectacled young genius is a PhD student in Seattle called Vamsi Talla. Remember that name. It will go down in history.

I first heard the name a couple of years ago when Talla published a proposal for a gesture-recognition system that ran on free energy. Unlike mains or battery-operated devices, his system would run on existing wireless signals such as TV transmissions, exactly as Tesla predicted. But it's relatively easy for a student to rehash the pioneering notions of a long-dead theorist. It's a miracle to make them work. And make them work is exactly what Vamsi Talla has done, all thanks to the wonders of Wi-Fi.

Wi-Fi signals are now ubiquitous – even I know that. And I also know that the energy lurking in ambient Wi-Fi signals can combine to produce enough voltage to run very low-power devices. The problem has always been that Wi-Fi signals only contain significant levels of power when data is being transmitted, and even then they're broadcast over a bunch of different frequencies. What Vamsi Talla has done is to set up a device – in this case a camera



– near an existing Wi-Fi hotspot, where it gathers energy and stores it. The trick is to modify the Wi-Fi router so that it broadcasts a minuscule pulse when any channel is not being used to send data. In other words, to create a continuous source on a single frequency. So far his camera can only filch enough power to take one photo every half an hour or so, but this is revolutionary stuff.

Two things are certain: electrical devices will become more energy efficient, and Wi-Fi will continue to spread like chlamydia. So what already works for a camera will be viable for all sorts of stuff, inside and outside the home. From doorbells to deaf aids, by way of smartwatches, thermostats, pacemakers, car keys, baby monitors, remote controls, you name it. But we'd better award Vamsi Talla his Nobel Prize and Blue Peter badge soon because I suspect a hit squad is after him already, and it's headed up by the Duracell Bunny.



Richard Easton

# RAVES

Richard gives his office chair its marching orders as he rediscovers the benefits of standing on his own two feet

**THE TYPICAL OFFICE** worker probably spends seven hours a day sitting at their desk, with an hour for lunch – a lunch that is probably then taken back to their desk to be part consumed and part spread all over their keyboard. After that they probably commute home by car, bus or train, and pray to the transportation gods to grant them a seat for yet more sitting.

That's an awful lot of time spent on our derrières for a species that used to be classed as hunter-gatherers. If science is to be believed, all that sitting is slowly killing us. I'm not in a medically qualified position to say whether or not this is true but I think we can agree that slouching for long periods probably isn't great for our posture.

For a while now, standing desks have been a popular choice for people who have suffered back injuries. However, they're also being adopted by those who wish to do something to reverse the sedentary lifestyles prevalent in modern society – or in other words, they want to spend less time sitting. For the past week I've been using a standing desk adaptor, which sits on top of a normal desk and lets you use two monitors and a keyboard and mouse while homo erectus instead of homo sedens (sedentus?). Surprisingly, even after such a short time I'm able to see some of the benefits of a standing desk.

Aside from the more obvious advantages, such as the supposed extra

calories you can burn from standing, there are a few welcome added extras. For example, I've noticed much-improved concentration when working. When you're sitting in a chair it's all too easy to lose focus as you slump, but standing seemingly forces you to engage not only your body but also your brain.

The space that the standing adaptor takes up also limits your desk space, but for me at least, this is certainly a good thing. It leaves far less room for knick-knacks, odds-and-sods, brick-a-brack and general detritus to collect. My desk is now de-cluttered and as minimalist as a designer's polo neck. A tidy desk is a tidy mind. I'm even eating my lunch standing up.



Chris Finnamore

# RANTS

Sucking in your cheeks and pouting for the camera is no longer good enough for the selfie-stick generation

**AS EDGAR ALLAN** Poe said, "There is no exquisite beauty... without some strangeness in the proportion". Mobile phone manufacturers, however, seem to be taking strange proportions to extremes.

Nearly every phone we review has a photo-editing mode designed to prettify selfies. These range from Samsung's, which lets you adjust facial characteristics such as eye size and face thinness, to the bizarre world of Sony, where you can apply filters

◆ Smartphone filters can bring out the beauty in the average *Shopper* staff writer



such as Cute, Youthful, Vintage, Suntan, Party or (please make it stop) Sweetie.

I'm generally not a fan of the extreme narcissism of the modern age – all those young folk with their 8-megapixel front-facing cameras, selfie sticks and duck faces constantly updating the world about what a great time they're having. As if it wasn't bad enough that anyone under the age of 25 is endlessly taking photos of their face to share with all and sundry, they now feel the need to alter those images to project the kind of person they'd like to be, all while embracing epithets

such as "geek" in the spirit of the Be True to Yourself ethos of *Glee* and *Frozen*.

There's also the small matter that the pictures the apps produce are terrifying. It's bad enough that all contours of your face are smoothed away and your eyes grow to preternatural proportions, but if you apply the filters multiple times to the same photo in order to multiply the beauty coefficient, you end up with a horrifyingly inhuman creature that looks as if it has fallen into a vat in Superdrug's research basement.

Of course, mobile phone manufacturers wouldn't include such features if they didn't feel there was a demand for it. For the sake of human civilisation, let's just stop taking photos of ourselves, and if we really must, let's just learn to love our little eyes and our wrinkles.



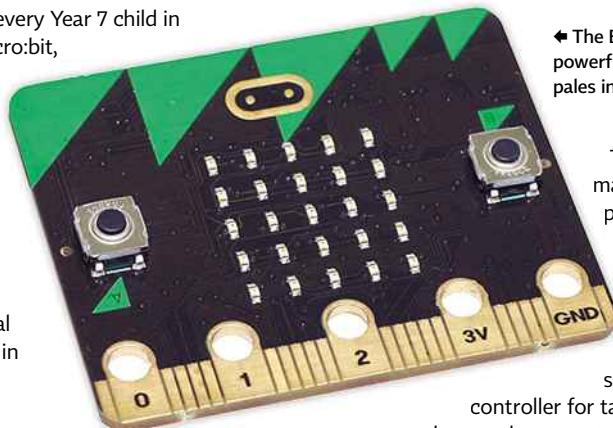
# BBC to give free micro:bit computers to all 11-year-olds

**THE BBC HAS** announced ambitious plans to give every Year 7 child in the country a free micro:bit computer. With the micro:bit, the BBC is following in the wake of the Raspberry Pi in providing a cheap, low-powered board that introduces children to coding.

The initiative has echoes of the BBC Micro, the Beeb-sponsored computer of the 1980s, which became one of the first computers in many school classrooms. This time the BBC and its partners plan to give away up to a million devices – enough for every 10- or 11-year-old child in the UK.

“Channelling the spirit of the Micro for the digital age, the BBC micro:bit will inspire a new generation in a defining moment for digital creativity here in the UK,” said the BBC’s director general, Tony Hall. “All you need is your curiosity, creativity and imagination – we’ll provide the tools. This has the power to be transformative for the UK.”

The micro:bit may be 18 times more powerful than the BBC Micro of the 1980s but it’s certainly no powerhouse by modern standards: its specification pales in comparison with even the £30 Raspberry Pi 2. It has a 32-bit ARM Cortex M0 CPU, no display output and no expandable storage. Indeed, it’s more of a controller than a standalone computer, and could even be a companion device for the Pi.



◀ The BBC micro:bit is 18 times more powerful than the original BBC Micro but pales in comparison with the Raspberry Pi

The 4x5cm board includes a matrix of 25 red LEDs, two programmable buttons, a motion detector and a magnetometer (or digital compass), as well as Bluetooth and five I/O rings for connecting devices and sensors. BBC demonstrations show the device being used as a

controller for tablets, to keep score during games and as a volume control for music equipment. The BBC will launch dedicated software that allows children to program the device from a PC, mobile or tablet.

The micro:bit will support Microsoft’s Touch Develop language, JavaScript, Python, C++ and Blocks. Programs are sent to a central server where they are compiled for the micro:bit before being downloaded and flashed on to the device over Bluetooth. The BBC says it will distribute the micro:bit to schools in October, giving teachers time to incorporate it in lesson plans for the rest of the academic year.

## BT announces first 4K sports channel

**BT ANNOUNCED THAT** its new BT TV Ultra HD set-top box will play host to Europe’s very first 4K live sports channel, BT Sport Ultra HD. The new channel launched on 2nd August with a live broadcast of the FA Community Shield match between Chelsea and Arsenal. BT Sport Ultra HD will also show games from the UEFA Champions League, Barclays Premier League and FA Cup, as well as Aviva Premiership Rugby and MotoGP, all in glorious 4K.

To get the channel, you’ll need to sign up for BT’s top TV package, Entertainment Ultra HD. This costs £15 a month and includes BT’s new 1TB Ultra HD YouView+ set-top box, which provides storage for 600 hours of SD or 250 hours of HD TV and 47 premium channels, including BT Sports Ultra HD. To sweeten the deal, BT is throwing in a £500 voucher towards an LG 4K UHD TV to help customers make the jump to 4K. However, you’ll also need BT Infinity 1 or 2 broadband and a fast enough line to support 4K streaming, so it could be a costly upgrade.

Delia Bushell, managing director of BT TV and BT Sport described BT Sport Ultra HD as “the next step in high definition TV”, adding that the channel “will bring you closer to the action than ever before. The picture quality is absolutely amazing – it’s four times the detail of today’s high definition TV. We are proud to be innovating and leading the UK TV market with our Entertainment Ultra HD package which offers customers the best in premium TV.”



In August, BT Sports Ultra HD customers will be able to watch two Barclays Premier League matches and the British GP in 4K

## Apple Pay launch misses key UK banks



**APPLE PAY HAS** gone live in the UK – but without support from three of the UK’s ‘big four’ banks. The cashless payment system for iPhone and the Apple Watch launched in the US at the end of 2014, with British retailers finally beginning to accept payments in July.

Of the UK’s major banking groups, only The Royal Bank of Scotland Group was there on launch day, including subsidiaries NatWest, Ulster Bank and The Royal Bank of Scotland. Customers of American Express, MBNA, Nationwide and Santander were also able to get in on the action, but HSBC users had to wait two weeks.

The rest of Britain’s banks remain on the sidelines. Lloyds and its subsidiaries Halifax and TSB are described as ‘coming soon’ on Apple’s website, as are Bank of Scotland, First Direct and M&S Bank. Barclays isn’t even on the list, although a Twitter post stated it would “bring Barclays debit cards and Barclaycard credit cards to Apple Pay in future”. Barclays revamped its own bPay cashless payment system in July, suggesting it’s concentrating on that for now.

Apple Pay can be used anywhere that accepts contactless payments, including McDonald’s, Costa, Waitrose and Wagamama. However, don’t get any ideas about wandering out to a restaurant without your wallet, unless you’re only planning to order starters. Apple Pay will initially be restricted to the same £20 limit as other contactless payment cards. An upgrade planned for the autumn will raise the limit, but only to £30.

Only Apple’s latest generation of devices supports Apple Pay.

● See feature, page 121



# Microsoft won't quit smartphone market

**MICROSOFT BOSS SATYA** Nadella has dismissed rumours that the company is preparing to pull out of the phone business, insisting it will continue to deliver Windows handsets even if no other manufacturers will. Rumours that Microsoft might quit the mobile business were given fresh impetus in July when the company announced massive lay-offs in its smartphone division.

The company made a further 7,800 staff redundant and wrote down the value of its mobile business by \$7.6 billion as Nadella announced that Microsoft would make far fewer models of its Lumia handsets in future. Despite buying Nokia's handset business for \$7.3 billion in 2012, Microsoft has struggled to make significant headway in mobile, with a single-digit market share in most markets.

However, in an interview with ZDNet, Nadella insisted the company isn't about to turn its back on smartphones. "We will do

everything we have to do to make sure we're making progress on phones," Nadella said.

"If no OEM stands up to build Windows devices we'll build them," Nadella added. "There will be Lumia devices."

Microsoft is currently the only major smartphone maker still turning out Windows Phone devices, but the lack of OEM enthusiasm doesn't seem to have deterred Nadella – at least, not publicly. The Microsoft boss even suggested that the company's Lumia handsets could be Microsoft's equivalent of the iMac, which helped swing Apple out of long-term decline. "You've got to remember even the Apple regeneration started with colourful iMacs," Nadella said. "So let us first get the colourful iMacs. I think with what we're doing with Lumia, we're at that stage. I want to do good devices that people like, and then we will go on to doing the next thing and the next thing."



Nadella promises that Microsoft will continue making Windows phones despite lay-offs

What's more, Nadella insists that one of the reasons he made Windows 10 a free upgrade for PC owners is to encourage more developers to write apps for Windows phones, as they can now write "universal" apps that work across mobile and desktop.

"If anything, the free upgrade for Windows 10 is meant to improve our phone position," said Nadella. "If somebody wants to know whether I'm committed to Windows Phone, they should think about what I just did with the free upgrade to Windows, rather than – hey, I'm making four more phone models of value smartphones."

## Samsung Galaxy Tab S2 to take on iPad Air

**SAMSUNG HAS REVEALED** details of two new flagship Android tablets: the Galaxy Tab S2 9.7 and 8.0. Both are slightly smaller than last year's equivalent Tab S models, which had 10½in and 8.4in screens, but each is just 5.6mm thick – thinner than Apple's iPad Air 2 and iPad Mini 3, which are 6.1mm and 7.5mm thick respectively. They're also lighter.

Samsung has also changed the aspect ratio from 16:9 to 4:3. The S2 9.7 has a 2,048x1,536 screen like the iPad Air 2, and the 8in version has the same resolution despite being almost two inches smaller. Samsung isn't letting Apple pull away with iOS 9's new split-screen feature, either, as both S2 models will display two apps simultaneously.

Each tablet's Super AMOLED display uses a new Adaptive Display technology, which adjusts the gamma, saturation and sharpness for the application in use, as well as the colour temperature according to the ambient lighting. Such automatic tools can be more of a hindrance than a help, so we'll examine that closely when we get our review units.

If we had one criticism of last year's Tab S range it was performance, but Samsung has beefed up the specs, opting for the same octa-core processor inside both models, as well as 3GB of RAM. Both tablets will come with 32GB or 64GB of storage and the option to add up to 128GB through the microSD card slot, as well as an 8-megapixel rear camera and a fingerprint sensor in the home button.

Following a deal with Microsoft, each tablet will ship with Microsoft Office apps for Android and 100GB of free OneDrive storage for two years. They will also be compatible with Samsung's Book Cover Keyboard, which turns your tablet into a makeshift laptop, complete with touchpad.

Samsung has yet to announce prices but says both models will be on sale from August in either Wi-Fi or 4G LTE versions and a choice of black or white.



## Ripping music and films is illegal (again)

**THE HIGH COURT** has once again deemed it illegal to make copies of CDs or DVDs you've bought in order to put them on your MP3 player or any other device. The ruling quashes a law brought in by the UK government last October, which finally made it legal to rip CDs to your home music library. Under the Copyright and Rights in Performances (Personal Copies for Private Use) Regulations 2014, you were allowed to make personal copies of your home media files for your own private use, which included storing them online or making backup copies. It was still an offence to share those copies or sell them on, but anyone wanting to transfer their CDs to their MP3 player or access their music through a cloud music player wouldn't face potential legal action.

Under the new ruling, though, making copies is once again illegal even for personal use. CDs, MP3s, DVDs, Blu-rays and eBooks are affected, but joke or parody versions of hit songs will escape criminal action. It's unclear how the ruling will be enforced.

The High Court ruled that the government was wrong not to introduce a compensation scheme for songwriters, musicians and other rights holders who face losses as a result of copyright infringement.

Speaking to the BBC, Jo Dipple, CEO of UK Music – a claimant in the case – welcomed the ruling: "Last month, the High Court agreed with us that government acted unlawfully when it introduced an exception to copyright for private copying without fair compensation. We therefore welcome the court's decision today to quash the existing regulations.

"It is vitally important that fairness for songwriters, composers and performers is written into the law. My members' music defines this country. It is only right that government gives us the standard of legislation our music deserves. We want to work with government so this can be achieved."



# Sky pushes for BT to be ripped in two

**SKY IS PUSHING** for BT to be split in two after accusing its rival of failing to repair and install new broadband lines promptly. Sky wants Openreach, the division of BT that manages the broadband and phone network, separated from BT Retail to ensure BT doesn't favour its own Retail division for repairs.

Sky claims that Openreach misses more than 500 appointments to install lines for Sky customers and fails to complete a further 4,000 every month, according to the *Financial Times*. It also claims that fault rates across the Openreach network increased by half between 2009 and 2012, the last year for which figures were made publicly available.

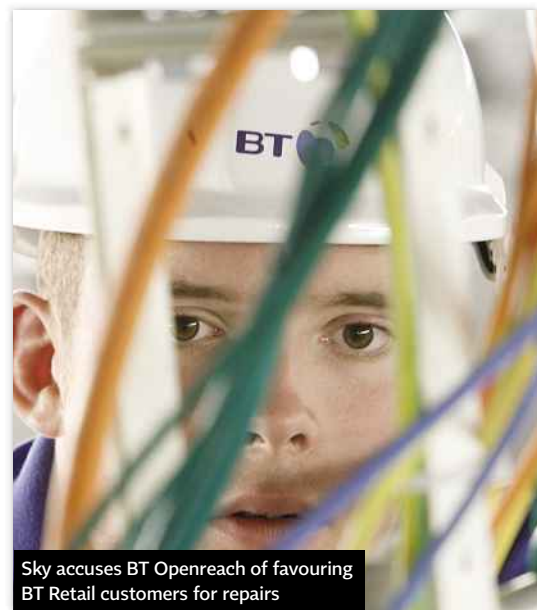
The company complains that BT is underinvesting and giving its own Retail division preferential treatment, an accusation BT denies. Sky wants Ofcom to force BT to spin off Openreach into a separate company.

The proposal comes in Sky's formal submission to regulator Ofcom's regular

review of the digital communications market. "We are drawing attention to the problems in broadband because they are important to the economy as a whole," Sky's chief strategy officer, Mai Fyfield, told the *FT*. "They affect competition between providers and have a direct impact on consumers and small businesses, resulting in inconvenience, dissatisfaction and loss of productivity."

Sky's intervention comes as BT faces scrutiny over its proposed £12 billion takeover of EE. The takeover is currently subject to an investigation by the Competition and Markets Authority and has raised concerns that BT will favour EE over other mobile providers by giving its own network cheaper access to bandwidth.

BT told the *FT* that it was "disappointing that Sky are engaging in selective spin rather than constructive dialogue," and that splitting Openreach from the rest of the company would "lead to huge uncertainty and fundamentally undermine the case for future investment".



Sky accuses BT Openreach of favouring BT Retail customers for repairs

## Adobe fixes fatal flaws in Flash

**ADOBE HAS FIXED** two serious flaws in Flash that could have allowed hackers to take control of infected PCs. The flaw was so serious that Mozilla banned Flash from running automatically in the Firefox browser.

The vulnerabilities were discovered in July and affected the latest version of the Adobe Flash Player and earlier versions for Windows, Mac and Linux. Worse still, attacks exploiting the flaws had been discovered, leaving systems with Flash installed vulnerable.

Adobe says it has patched the software and taken steps "to ensure that this class of attack cannot be used as a future attack vector". The company says it is "pushing the update out to users" and working with browser vendors to distribute the update. Flash is built into Google's Chrome browser, for example, although as more sites move to HTML5 for video and interactive content, that may not be the case for long.

Flash has one of the worst security records of any software, including Windows. A 2013 study by AV-Test found that Adobe's Reader and Flash and Oracle's Java software were responsible for two thirds of all the vulnerabilities on Windows PCs. Flash was fifth on the list.

Steve Jobs famously refused to allow Adobe's software to run on the iPhone, stating that "we don't want to reduce the reliability and security of our iPhones, iPods and iPads by adding Flash," in 2010.

In its defence, Adobe says Flash is targeted because of its popularity. "Flash Player is one of the most ubiquitous and widely distributed pieces of software in the world, and as such, is a target of malicious hackers," Adobe wrote on a blog announcing the latest fixes. "We are actively working to improve Flash Player security, and as we did in this case, will work to quickly address issues when they are discovered."

That's unlikely to be enough to appease Facebook's new security chief, Alex Stamos, who has urged Adobe to announce an end-of-life date for Flash.



## New iPod touch gets a power boost

**APPLE HAS REFRESHED** its iPod range of portable media players for the first time in three years. The iPod touch has received the most significant upgrade, as the 2015 model is now powered by one of Apple's 64-bit A8 chips, the same chip that's inside the iPhone 6. Its processor performance will be up to six times faster than that of the previous iPod touch, according to Apple, while GPU performance will be up to 10 times faster. Like the iPhone 6, the iPod touch 2015 also takes advantage of Apple's M8 Motion coprocessor, which has a built-in gyroscope and accelerometer to monitor your fitness.

The media player still has a 4in 1,136x640 display, but adds a new 8-megapixel iSight camera and an improved FaceTime HD camera, allowing you to take more detailed pictures and get creative with its 120fps slo-mo and burst selfie modes. The new iPod touch will also have Apple Music, which can be found in the Music app.

The new iPod touch comes in various colours, including space grey, blue, gold, pink and silver, and four storage sizes, including 16GB, 32GB, 64GB and 128GB – priced at £159, £199, £249 and £329 respectively.

The iPod shuffle and nano on the other hand have remained largely unchanged. They do, however, now come in the same new colours as the iPod touch 2015.

The iPod was one of the products that helped transform Apple's financial fortunes at the start of the 21st century, but Apple's latest annual earnings show that sales are down

48% year on year. Even finding the devices on Apple's website is a challenge now, as the iPod is no longer afforded a tab of its own at the top of the company's homepage.



◀ The iPod touch, iPod nano and iPod shuffle are now available in a range of new colours



# Nest Cam launches in the UK

**SMART THERMOSTAT MAKER** Nest has launched its smart camera in the UK. Priced at £159, the Nest Cam lets you monitor your home from afar using a smartphone app.

The Nest Cam is the first such product to appear since Nest bought IP camera creator DropCam, and it certainly bears the hallmarks of its forebears. With its magnetic base, it can be attached to various surfaces around the home, but can also be wall mounted or free standing with its built-in stand and standard tripod mount.

The camera has a 130° field of view and an infrared night-vision mode, so the lights don't need to be on for it to spot a burglar creeping across your living room. Video is captured in Full HD at 30fps, and the Nest Cam supports dual-band 802.11bgn Wi-Fi to stream the footage across your home network.

The camera offers motion and sound detection, while the accompanying smartphone app alerts you if it detects something. Nest says the camera can distinguish between background noise, such as traffic, and significant noise, such as an intruder crashing through the back door.

The Nest Cam isn't only useful for monitoring, though. It can also be used to keep in touch with people (or even pets) at home thanks to its built-in mic and speaker. You can pre-programme spoken commands and then tap a button in the app to tell the dog to "get down" or "be quiet".

The camera also works in conjunction with Nest's other smart home products. Switch the Nest Thermostat to Away, for example, and the



With its bulbous 1080p camera and magnetic stand, the Nest Cam is a reimagining of the DropCam Pro

Nest Cam automatically starts recording and monitoring for intruders in the home. Likewise, recording kicks in if the Nest Protect smoke alarm detects a fire.

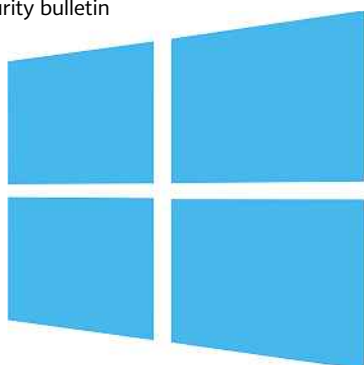
Nest sells an £8 monthly subscription package with the camera that lets you store up to a month's worth of footage in the cloud and create time-lapse videos from recordings. The Nest Cam is on sale now from the Nest website.

# Emergency patch issued for all versions of Windows

**MICROSOFT HAS BEEN** forced to issue an emergency patch for all currently supported versions of Windows after hackers found a way to take remote control of computers by getting users to download infected fonts. The fix covers all versions of Windows released since Vista, including the Windows 10 Insider Preview.

Microsoft reserves emergency patches for the most serious flaws – even "critical" bugs are fixed in the regular monthly update. Microsoft's move to shut down this flaw suggests the company knows an attack is imminent, although at the time of writing, Microsoft's security bulletin stated that it "did not have any information to indicate this vulnerability had been used to attack customers".

This attack concerns the way Windows Adobe Type Manager Library handles OpenType fonts. "The vulnerability could allow remote code execution if a user opens a specially crafted document or visits an



untrusted web page that contains embedded OpenType fonts," Microsoft's bulletin states. Microsoft says that hackers could take complete control of the user's system, allowing them to "install programs; view, change, or delete data; or create new accounts with full user rights".

The emergency patch is being pushed out through Windows Update, which means the fix will be installed automatically, unless you've taken the precarious decision to check for updates manually.

Given that the flaw affects every currently supported version of Windows, including Windows RT and Windows Server, it's highly likely the bug will also affect Windows XP, for which Microsoft no longer issues security updates. Users of Windows XP systems will therefore remain vulnerable to the attack, unless their security software is able to detect and quarantine the malicious font files.

**palicomp**  
www.palicomp.co.uk  
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**Sale price**  
**£429.99**  
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(Code - HAS2)

## INTEL Haswell Sphere

INTEL Haswell i5 4430 @ 3.0Ghz (Quad)  
ASUS Z87-K Motherboard  
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500GB Hard Drive  
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INTEL HD4600 Graphics



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ASUS M5A78L-M/USB3 Motherboard  
PATRIOT VIPER RED V3 8GB 1600Mhz RAM  
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AMD Radeon HD7770 1GB Graphics



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(Code - PHO11)

## Phoenix i5 Vortex

INTEL Haswell i5 4670K @ 3.4Ghz (Quad)  
Overclocked To 4.4Ghz Per Core  
ASUS Z87-K  
PATRIOT VIPER RED V3 8GB 1600Mhz  
2TB SATA2, 3Gb/s  
SONY 24X DVD+/-RW  
nVIDIA GTX660 2GB



# Commodore PET returns as a smartphone

**THE BELEAGUERED COMMODORE** brand has made more comebacks than Status Quo. Now the name is being given one more outing, this time on a smartphone that contains both Commodore 64 and Amiga emulators.

The Commodore PET, named after the 1970s computer that preceded the VIC-20, Commodore 64 and the Amiga, has a decent specification: a 5½in Full HD IPS display, a quad-core 1.7GHz CPU, 32GB storage – expandable to 64GB with microSD – and 3GB of RAM. The PET supports 4G LTE and has an 8-megapixel front-facing camera and a 13-megapixel snapper on the rear.

It runs a customised version of Android 5.0, but the feature most likely to appeal to retro gamers is its emulators. A *Wired* report claims

the smartphone ships with customised versions of the VICE C64 emulator and the Uae4All2-SDL Amiga emulator, and that the manufacturer is working with software houses to bundle some 1980s classics with the phone. Don't expect too much, though, as similar plans to revive the Spectrum ended in legal disputes.

The Commodore brand has been rehashed several times since the company went bust in the mid-1990s. It was acquired by Dutch PC maker Tulip and used on a series of entertainment products. Separately, the name was attached to a range of high-end gaming PCs in the late 2000s.

The Commodore PET smartphone is available to buy now for €289 for the 16GB version or €349 for the 32GB version.



## Samsung disables Windows updates

**SAMSUNG HAS BEEN** accused of disabling Windows Update on some of its laptops, potentially leaving customers exposed to security flaws. The company reportedly shut down Windows Update in favour of its own utility, which is bundled with certain Samsung's laptops.

The discovery was made by Microsoft Most Valuable Professional (MVP), Patrick Barker, who documented how Samsung laptops run an executable called Disable\_Windowsupdate.exe. The executable is part of Samsung's SW Update software, which Barker describes as "your typical OEM updating software that will update your Samsung drivers, the bloatware that came on your Samsung machine and so on."

It seems Samsung is shutting down Windows Update to ensure it doesn't interfere with its own update tool. In an online conversation with a Samsung support representative, the technician told Barker that Windows Update installs default drivers for the hardware, which may not work. "To prevent this, SW Update tool will prevent the Windows updates," he said.

The danger is that by shutting down Windows Update, users miss security patches, which could leave their PCs exposed. "Why would you ever disable WU in such a fashion (or in general), in a way a generic user cannot control, leaving them vulnerable?" Barker asks on his blog.

A spokesperson for Samsung told *Computer Shopper* that the feature was optional. "It is not true that we are blocking a Windows 8.1 operating system update on our computers. As part of our commitment to consumer satisfaction, we are providing our users with the option to choose if and when they want to update the Windows software on their products. We take product security very seriously and we encourage any Samsung customer with questions or concerns to contact us at 0330 726 7864."

Samsung isn't the first PC maker to be accused of imperilling customers' security with bundled bloatware. Earlier this year, it was revealed that Lenovo had installed a piece of software called Superfish on selected models of its laptops, which inadvertently made it possible for snoopers to monitor customers' web traffic. Lenovo later pulled the software and distributed a tool to remove it.



## Mobile data filling in for poor home Wi-Fi

**ONE IN FOUR** people in the UK are forced to use their mobile data to counteract terrible home Wi-Fi coverage. A study revealed that 40% of Britons are now using mobile data at home out of habit, while one in seven have home Wi-Fi that's too slow to meet their streaming needs.

The data is from a poll commissioned by mobile network analysis firm Global Wireless Solutions, which recently unveiled the extent of mobile phone black spots in the home and on London's busiest train lines. Of 2,000 UK adults polled, 16% said that while they were able to connect mobile devices to their home network, the connection was so slow that they typically used mobile data instead. Meanwhile, 13% said they never connect their mobile devices to their home network. The poll also revealed that bedrooms are often the worst rooms in British houses for Wi-Fi, followed by kitchens and then living rooms.

Combined with GWS's recent study on mobile phone black spots in the home, this paints a sorry picture for the state of Britain's internet. GWS analysed 4G signals inside and outside more than 50 London homes, and found that Three and EE were the least reliable for 4G coverage indoors.

"Network operators are under a great deal of pressure to improve the UK's mobile networks and eliminate signal black spots around the country," said Paul Carter, CEO of GWS. "Most major network operators offer their customers voice-over-Wi-Fi services as a temporary solution to in-home black spots, but as our poll shows, Wi-Fi connectivity in British homes is often too slow or patchy for consumers to reliably access the Internet. These same Wi-Fi issues will affect consumers hoping to use voice-over-Wi-Fi to make calls at home."

"Today's Brit is adept at switching between Wi-Fi and mobile data to stay connected while they are out and about, but they shouldn't have to use the same tricks to get online at home."



According to new data from GWS, poor home Wi-Fi speeds are forcing people to use their mobile data allowance to get online



## EE and PlusNet top complaints report

**DON'T WANT TO** spend time making angry phone calls to customer service desks? Then you'd better avoid BT and its associated companies, according to data from Ofcom. For the fourth quarter in a row, EE, which BT is trying to buy for £12.5 billion, was the most complained about landline provider, with 0.36 complaints per 1,000 customers. The biggest single complaint was over difficulty in changing provider, accounting for 33%.

EE was closely followed by BT-owned PlusNet, with 0.20 complaints per 1,000 customers, while BT and TalkTalk also generated more than the industry average level of 0.13 complaints. The least complained about companies were Sky, with 0.05 and Virgin, with 0.07 complaints per 1,000 customers.

For broadband, EE was again the most complained about company, generating 0.51 complaints per 1,000 customers – the highest level since early 2013. BT, PlusNet and TalkTalk again surpassed the industry average for complaints, while at the other end of the scale, Sky just pipped Virgin Media to best performing broadband provider.

BT is the most complained about pay TV provider for the ninth quarter in a row with 0.15 complaints, closely followed by TalkTalk. Sky remains the best-performing pay TV provider and was the only one to get fewer complaints than the industry average at 0.01 per 1,000.

Vodafone takes some of the heat off BT as the most complained about mobile network for the second successive quarter with 0.14 complaints per 1,000 customers. Virgin Mobile, O<sub>2</sub>, Three and Tesco Mobile all generated complaints below industry average, with Tesco Mobile generating the least for the fourth consecutive quarter.

Ofcom has since fined EE £1 million for failing to comply with rules on handing complaints. It found that EE didn't give customers accurate or adequate information about their right to take their complaints to alternative dispute resolution schemes between 2011 and 2014.



## MS Office now syncs with Google Drive

**MICROSOFT OFFICE USERS** can now save to and open from Google Drive, giving them another cloud service to sync with. Microsoft's OneDrive storage is built into Office applications, but now Google is getting in on the act with its Drive plug-in for Microsoft Office.

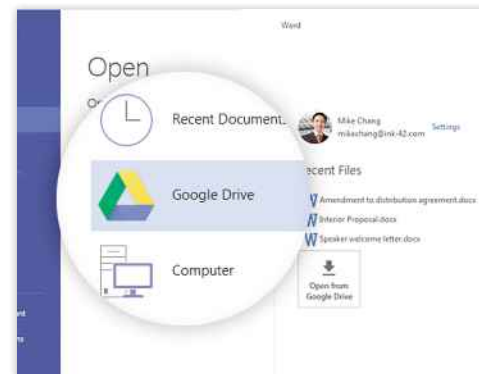
Once installed, the plug-in lets you save and open files in Google Drive as you would from OneDrive, although there are limitations. Files must be saved as .doc or .docx to open in Word, for example, and files created in Google Docs aren't compatible with Office applications.

In truth, it's not much different to having Google Drive installed on the PC, but if you don't want to sync your Google Drive locally, this new plug-in lets you access individual files stored online.

Microsoft has been cooperating with rival cloud storage services recently. Earlier this year it added Dropbox support to its Office apps for iOS and Android, and Dropbox is also integrated with Microsoft Office Online, so users can edit files stored in Dropbox using the browser-based versions of Word, Excel and PowerPoint.

Microsoft is currently beta testing Office 2016, the next generation of the Office desktop software, and has created new Office Mobile apps for Windows 10, which consume a fraction of the storage space of the full desktop suite at the expense of many advanced features.

➔ When you start up Word 2016, you'll be able to open documents straight from Google Drive



## Hackers kill Jeep brakes while driving

**HACKERS MANAGED TO** disable the brakes of a Jeep Cherokee remotely while the vehicle was moving in the most alarming breach of car security to date. The hack was performed as part of an experiment in the US, during which the hackers also took control of the car's transmission, entertainment system, air conditioning and windscreen wipers.

The hack was conducted by Charlie Miller and Chris Valasek, who have a long history of breaking into car computers. With a *Wired* reporter behind the wheel, the pair were able to knock out the brakes, rendering the brake pedal useless and sending the car into a ditch.

During the experiment, the hackers also cut the car's transmission as it was travelling at 70mph, causing the Jeep to lose speed suddenly. They took control of the air conditioning, blasting the driver with cool air, switched the car stereo up to maximum volume and engaged the windscreen wiper and washers – all of which could cause a driver to lose concentration.

The pair could even take over the steering, although only when the car was travelling in reverse. *Wired* reports that Miller and Valasek are confident they can find a way to move the

wheel while the Jeep is travelling forwards at speed, however.

The pair performed all these actions from 10 miles away using the car's Uconnect feature, which allows drivers to hook their smartphone to the in-car entertainment and navigation system. They plan to disclose full details of the vulnerability at the Black Hat security conference in Las Vegas.

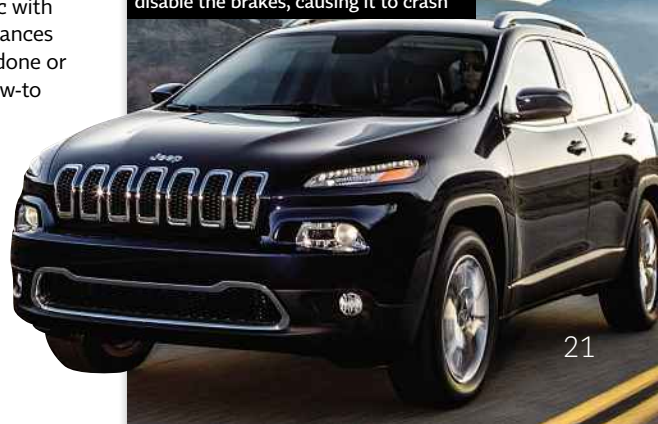
In the meantime, researchers have shared their findings with Jeep manufacturer Chrysler, which released a patch to fix the vulnerability. Sadly, it must be installed manually from a USB stick or at a dealership, so thousands of vehicles are likely to remain unpatched when details of the flaw are published.

In a statement sent to *Wired*, Chrysler urged the researchers not to go public with their information. "Under no circumstances does [Fiat Chrysler Automobiles] condone or believe it's appropriate to disclose 'how-to information' that would potentially encourage, or help enable hackers to gain unauthorised and unlawful access to vehicle systems," the company said. "We appreciate the contributions of cybersecurity

advocates to augment the industry's understanding of potential vulnerabilities. However, we caution advocates that in the pursuit of improved public safety they not, in fact, compromise public safety."

Miller and Valasek still plan to publish, however, arguing that it will force car manufacturers to improve their security. "If consumers don't realise this is an issue, they should, and they should start complaining to carmakers," Miller told *Wired*. "This might be the kind of software bug most likely to kill someone."

Hackers not only managed to cut out the Cherokee's transmission but also disable the brakes, causing it to crash



# Virtual reality check

Sony's Project Morpheus VR headset is nearly here. We go hands-on with some of the latest demos to see if virtual reality is the next big frontier for gaming

**AT SONY'S RECENT** summer showcase in London, we had another chance to try out the company's virtual-reality headset, Project Morpheus. We weren't impressed after our first Morpheus experience at last year's E3 games show, but after playing Sony's latest set of VR titles, it's clear that Project Morpheus has come a long way since those early demos. We came away feeling more confident about the future of virtual reality, and it's possible that Project Morpheus might have the edge over its main rivals Oculus Rift and the HTC Vive. Here are our impressions of the game demos we saw.

## HEIST OF THE CENTURY

The demo that really won us over was *The London Heist*. This placed us in the shoes of a jewel thief, rooting through the desk of a Russian mobster. Thanks to the Morpheus headset's 5.7in 1,920x1,080 OLED display (that's 960x1,080 pixels for each eye) and 100° field of view, the ornate study burst into life as soon as we slid the Morpheus over our eyes. The headset is surprisingly lightweight, and we almost forgot it was there as we soaked up our surroundings. Two PlayStation Move controllers morphed into our own set of disembodied digits, allowing us to grab, pull open and rifle through each drawer by holding down the controllers' rear button and moving our arms as we would normally.

The Move controllers are tracked by Sony's PlayStation Camera along with the LEDs on the front of the headset, allowing us to move from side to side as well as crouch behind the virtual desk when a passing guard made a nocturnal sweep of the building. We got caught peering round the corner to see if the coast was clear, prompting dozens of armed guards to pour in from outside and up



After a slight bout of vertigo, we were quickly gunning down enemy space ships like a seasoned fighter pilot

above in the balcony. Using the desk for cover, we grabbed the nearest ammo clip from a drawer and shoved it into our empty pistol as naturally as we might do with our own two hands. It was this moment that really sold us on Project Morpheus, as that simple action of reloading our gun made us feel truly immersed in the world of the game.

## RIDE OF THE VALKYRIES

We were also impressed with CCP Games' 360-degree space shooter, *EVE: Valkyrie*. Admittedly, this was the only demo we tried that made us feel slightly motion-sick, but swooping into battle from our virtual cockpit and watching battles play out all around us is definitely what virtual reality is made for.

*EVE: Valkyrie* was one of the few demos that made use of our rear view, too. Thanks to a small window at the back of the ship, we could turn round in our seat to scout out any would-be attackers on our tail. It took a while to break down the years of muscle memory of always looking straight ahead in games, but looking out of our glass cockpit quickly became very intuitive. Likewise, it's only by leaning forwards and glancing up at the huge monolithic motherships outside that you realise the scale of what CCP has built in order to make this world so engaging.

## TANKED UP

For those who'd rather keep their feet on the ground, Rebellion's remake of Atari classic *Battlezone* places you deep inside the confines of a futuristic tank. While there's no rear window here, your cockpit provides a surprisingly wide vista of your surroundings, and the DualShock 4's smooth controls make full use of Morpheus's 120Hz refresh rate.

Much like *EVE: Valkyrie*, you'll need to move your head to widen your field of view, as enemies spawn procedurally from all angles. Once we'd taken out a wave of tanks and turret towers, we were suddenly flanked by a flurry of airborne robots, which made a beeline for our tank with their deadly lasers.

Fortunately, your tank is also armed with a machine gun, allowing for more accurate aerial takedowns, and a boost jump. This rockets your tank up into the air before plummeting back down with a palpable thud, making for an immersive dodge tool as well



Most VR games are single-player experiences, but Playroom VR allows you to play with up to four friends on the TV





Thanks to Sony's Move controllers, The London Heist lets you use your hands to interact with in-game objects

as a rather flamboyant way of overpowering other land-locked combatants.

## STEP INTO THE KITCHEN

Another genre primed for virtual reality is the good old-fashioned horror game, and Capcom's *The Kitchen* tech demo gave us a terrifying glimpse of what the developer could do with a fully fledged title. You can't move in this particular experience, as you're conveniently bound to a chair, but the action playing out around you is truly terrifying.

As we awoke in the dark, dank kitchen, we quickly saw another dazed individual rousing beside us. Fortunately, he was friendly, despite touting a worryingly large knife as he hobbled towards us. His intention was to cut us free, although judging by the state he was in, he could have easily sliced us through the chest had we not kept our DualShock-mapped hands perfectly still as he laboured away at the wire. Still, while our brain knew this man was made out of polygons, we couldn't help but physically veer away when we thought our friend's blade was getting too close for comfort.

It was only when we noticed that our virtual legs seemed to be protruding out of our stomach that the illusion was momentarily broken. However, all was quickly forgotten when a long-haired woman emerged from behind, stabbed our friend through the neck and dragged him off to his doom. All we could do was listen to the hellish noises shrieking out of our headphones, until we too met our untimely demise as she yanked our head backward and brought the knife down into darkness.

It was an experience like no other, but it did highlight one of the main issues that *Morpheus* and VR headsets in general have yet to overcome – and that's actions that affect your virtual in-game body. At one point, for instance, our resident demon lady plunged the knife right into our thigh, but the lack of physical feedback meant it had no impact whatsoever, and could have easily been missed had we been looking the other way. This is a shame, but unless

developers can trick us into thinking our virtual body is our own, such actions will likely fall short of expectation no matter which VR headset you decide to wear.

## LEVEL PLAYING FIELD

Virtual reality needn't be a solitary experience, as Sony Japan Studio's *Playroom VR* showed us a great example of how *Morpheus* can be brought into the living room without isolating friends and family. In this demo, we went controller-free as a rampaging cartoon dragon, smashing everything in our path with a firm nod of our head.

Meanwhile, three other players were controlling a tiny force of fighter robots on the TV, throwing everything from giant pink pianos to tiny garden chairs at us to ward off our assault. This in turn forced us to duck and dive as we fought to survive. It's a similar concept to some of the asymmetric games we've seen on the Wii U, but in terms of immersion, VR *Playroom* is the clear winner – at least for the player using *Morpheus*. We only hope the rest of the mini-games in VR *Playroom* are as fun and innovative when the game launches next year.

## VIRTUAL FUTURE

There's still a lot we don't know about Project *Morpheus*. Sony has only announced a vague launch

window of the first half of 2016, with no official price or confirmation on whether the required PlayStation Camera will be included with the headset. The HTC Vive headset, on the other hand, is due to arrive in the shops in time for Christmas, while Oculus Rift is currently dated for Q1 next year, making *Morpheus* one of the last VR headsets to make its way to market. Still, from what we've seen so far, Sony has made a compelling case for going its own way in virtual reality, and it's by far the most consumer-friendly package we've seen.

We still don't know when Oculus Rift will launch its motion-tracking Touch controllers, as the models shown off at E3 this year were still early prototypes, and the additional room sensors needed to make the most of Valve and HTC's Vive headset may not be practical for many households. Oculus Rift also requires a pretty powerful PC in order to run, and while Vive's recommended PC specs are still shrouded in mystery, we wouldn't be surprised if they were very similar to what's required for Oculus Rift.

Project *Morpheus*, on the other hand, slots right into the PS4 ecosystem, and all its various accessories are readily available. Sony still needs to persuade consumers that virtual reality isn't just another gimmick, but in our eyes, it's the most viable and complete VR experience on the horizon. Project *Morpheus* may be the last headset to hit the shops but, as long as Sony gets its pricing right, it could be the life and soul of the VR party. **CS**

*Morpheus* doesn't have any built-in audio, so you'll need to wear a pair of headphones over the top



# REVIEWS

## YOUR TRUSTED GUIDE TO WHAT'S NEW

### 4K VIDEO-RECORDING DRONE

## DJI Phantom 3 Professional

**COMPUTER SHOPPER** ★★★★★

**RECOMMENDED** £1,159 inc VAT • From [store.dji.com](http://store.dji.com)

### VERDICT

Its stunning aerial photography comes at a price, but the Phantom 3 Professional is worth every penny

### REMOTE-CONTROLLED QUADCOPTERS,

more commonly known as drones, are big news right now. Unfortunately, this is partly down to irresponsible pilots flying them too close to commercial airliners and public buildings, but for anyone more responsible who's interested in aerial photography, they're a gateway to capturing amazing footage of the world from above. They're also, when flown safely, brilliant fun.

DJI is arguably the best-known drone manufacturer, and with good reason: its Phantom-badged drones are highly advanced, with integrated GPS for safe flying, intuitive controls and a brilliant app for tablets and smartphones that gives you a live view from the camera mounted under its four rotors. The Phantom 3 Professional is the latest model in the range. With a longer-lasting battery and a camera that can record 4K footage, stabilised by a three-axis gimbal, it's one of the most comprehensively equipped drones you can buy today.

### FLOATING ROTOR

Like most consumer drones, the Phantom 3 uses a quad-rotor design for balanced flight. The 4K camera is mounted beneath on a three-axis gimbal to keep your footage free from camera shake, and landing gear protects the electronics from bumps on landing.

A fully stabilised flight controller takes out almost all the difficulty of flying the drone, and integrated GPS ensures that it stays in place when you want it to. When GPS isn't available, DJI's own visual positioning system (VPS) helps keep the Phantom 3 hovering – the downwards-facing camera and two ultrasonic sensors work brilliantly, creating a real-time map of the ground under the drone. This means you could feasibly use it indoors, but although it looks deceptively small, the

propeller span of 590mm means the Phantom 3 is mostly suited to outdoor flight – for safety reasons as much as anything, as the propellers don't have guards. In the open air, it can fly up to 400 feet vertically and get up to 1.2 miles away from the control unit.

### AIR TRAFFIC CONTROL

The controller is incredibly comprehensive, with buttons for operating the camera, turning recording on and off and taking still photos during flight, as well as twin sticks for drone movement and a mounting point to attach a smartphone or tablet. The mount is adjustable, so it will hold any phone or tablet up to the size of an iPad Air, and grips tightly to ensure your device won't fall out.

A USB port on the back lets you connect your tablet or phone to the controller to enable live streaming from the Phantom's camera at 720p resolution. Both iOS and Android are supported, so most people should be able to use the app. The controller finally has its own internal rechargeable battery, too, which is a huge improvement over the AA battery-

powered controller that shipped with previous versions of the Phantom.

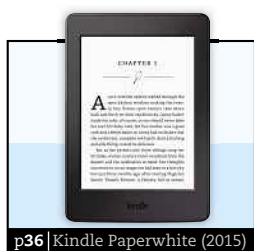
You don't need to connect a mobile device to fly the drone, but the live view is a real advantage when capturing stills and video. It fills most of the screen and makes it much easier to line up your shots than by eye alone. The free DJI Pilot app also gives you full control over camera shutter speed, ISO sensitivity, white balance, resolution and video frame rate, as well as providing automatic take-off and landing buttons, a GPS overlay indicating your altitude and a signal strength indicator showing how far the drone is from the controller.

The app also shows you how much flight time you have remaining. The Phantom 3 can last for up to 23 minutes on a single charge, although that falls if the drone has to fight strong winds. A warning appears when the battery is almost empty, prompting you to return the drone to your take-off site, and the Phantom will land automatically if the battery gets critically low.

New pilots can practice flying the drone with the







p36 | Kindle Paperwhite (2015)



p42 | Acer Predator XB270HU



p50 | GoPro Hero4 Session



p56 | XFX Radeon R9 380 4GB



p62 | Batman: Arkham Knight

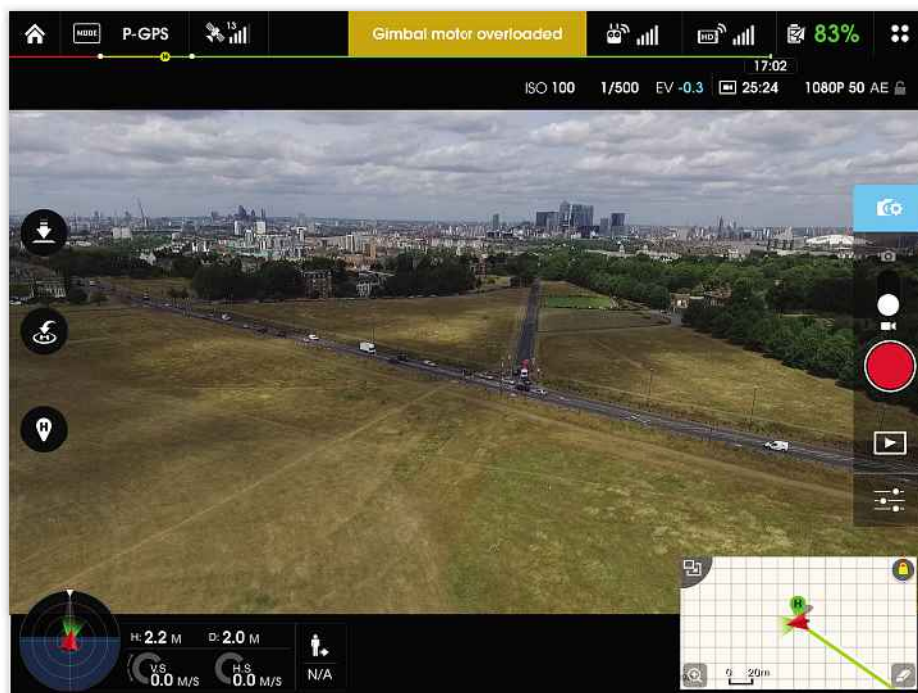
Phantom simulator, which uses the controller and app to help you familiarise yourself with the controls you'll need to pilot it outdoors. We found this very useful when high winds prevented us taking the Phantom 3 outside.

### FIELD OF VIEW

It's the 12.4-megapixel, f/2.8 camera bolted to the Phantom 3's undercarriage that turns the drone from a hobbyist toy into an aerial photographer's dream. The 94° field of view virtually eliminates fisheye distortion and avoids capturing the landing gear when taking stills or video. Our test shots looked incredibly punchy and vibrant, with an impressive level of detail, but it's when recording video that the Phantom 3 truly shines. The 4K footage captured by the Professional model is pristine, rivalling anything we've seen from the likes of GoPro or other action cameras.

A cheaper model – the £900 Phantom 3 Advanced – shoots at a lower video quality of 1080p but retains all the other features found in the Professional version. It even uses the same sensor, so still image quality should match that of the Professional model.

The camera's three-axis gimbal kept the image perfectly still during flight, even when winds picked up to 10mph. We spotted a small amount of camera shake when flying at top speed, but in steady flight you should be able to take perfectly stable shots. You



▲ The DJI Pilot app has every button within easy reach, but the highlight is definitely the 720p live view

before take-off, though: the Civil Aviation Authority (CAA) is still in the process of defining rules and regulations for drone pilots, but until laws are passed, users need to follow the so-called Drone Code ([tinyurl.com/dronecode](http://tinyurl.com/dronecode)) to remain within the law.

Essentially, you need to ensure you can see your drone at all times, avoid flying higher

concerts and sports events. Finally, you can only fly drones on private property or public green land – otherwise you need permission from the landowner to fly over it. All these rules can seriously limit your ability to fly legally so, depending on where you live, you may have to travel in order to get in the air.

### DRONE TO PERFECTION

The Phantom 3 Professional is a brilliant way to get into aerial photography, with intuitive controls, simulations to help you improve your flying abilities even when the drone is grounded, and stunning image quality. It's expensive, but considering it shoots 4K footage and is so easy to use that you don't have to be an experienced radio-controlled aircraft pilot in order to fly it, we think it's worth the investment if you want to produce some stunning aerial video or photos.

Tom Morgan

## A fully stabilised flight controller takes out almost all the difficulty of flying the drone, and integrated GPS ensures that it stays in place when you want it to

can't rotate the camera, so you have to turn the drone instead to get the shot you want. This requires a steady hand, especially when you're also using the vertical tilt wheel to angle the lens up and down.

### FLIGHT CASE

When you first take the drone out of the box, you simply have to screw a rotor blade on to each propeller, plug in the battery pack and power the Phantom 3 on before you're ready to fly. There are other things to bear in mind

than 400 feet, keep it well away from aircraft, helicopters, airports and airfields and, above all, fly safely – you could be prosecuted if you don't. As with all DJI drones, the Phantom 3 is geo-fenced to prevent it straying into certain areas such as airports, but you'll still need to act responsibly when flying.

There are other factors to be aware of, too. Because the Phantom 3 is fitted with a camera, you're not allowed to fly it within 50 metres of people, vehicles, buildings or structures, or large gatherings such as

### SPECIFICATIONS

**MAX SPEED** 16m/s (ATTI mode, no wind) • **GPS MODES** GPS, GLONASS, VPS • **GIMBAL PITCH** -90° to +30° • **GIMBAL STABILISATION** 3-axis (pitch, roll, yaw) • **MAXIMUM PHOTO RESOLUTION** 12.7 megapixels • **MAXIMUM VIDEO RESOLUTION** 4,096x2,160 at 24/25fps • **FLIGHT TIME** 23 minutes • **WEIGHT** 1.2kg • **PROPELLER SPAN** 590mm diagonal • **DETAILS** [www.dji.com](http://www.dji.com)

ASUS

## Chromebox M031U

£209 inc VAT • From [www.ebuyer.com](http://www.ebuyer.com)

## VERDICT

A charming little Chrome OS-based PC with surprisingly sprightly performance

**CHROME OS HAS** long been associated with budget laptops; the lightweight operating system and browser-based applications are well suited for people with modest needs when on the move. We've seen substantially fewer desktop-based Chrome machines but, when you think about it, there's no reason a Chrome desktop PC can't be a great buy.

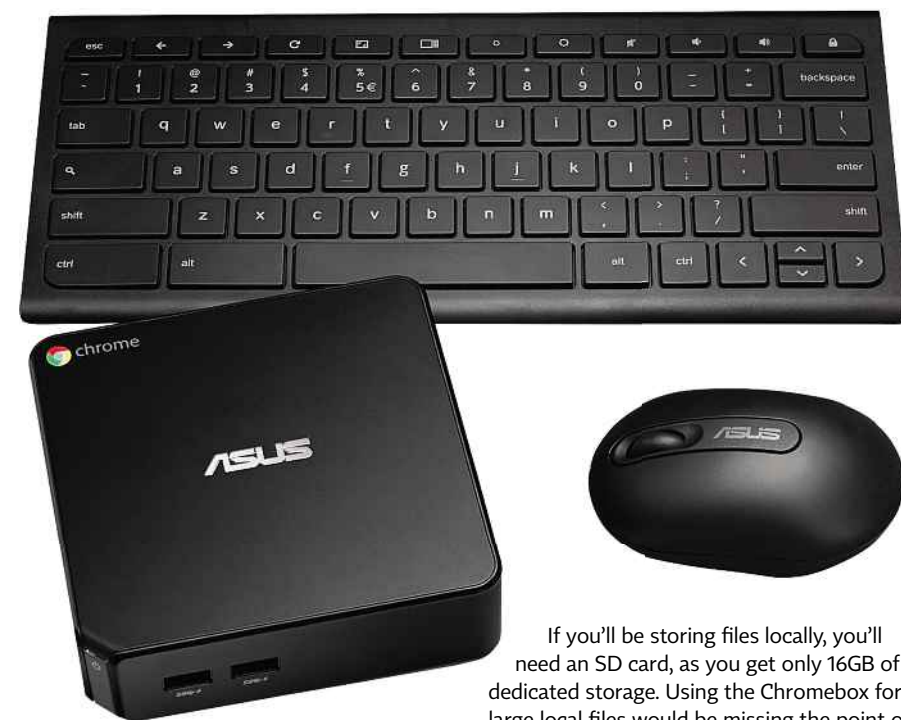
Step in the Asus Chromebox. It's a pleasingly designed mini-PC, with a footprint a little smaller than a CD case. Its tiny size means it can fit practically anywhere: on a desk, on the back of a monitor (with a mount) or even in your media cabinet if you fancy a dedicated web-browsing PC for your TV. The dark metallic blue top and black sides look classy and don't give away the cheap origins.

In such a small form factor the Chromebox would be forgiven for failing to provide all the ports and connectors you'd expect of a larger PC, but it's actually surprisingly well equipped. You get full-size HDMI and DisplayPort connectors at the rear, along with two USB3 ports, a Gigabit Ethernet connector and 3.5mm headset jack. There are two more easily accessible USB3 ports on the front of the Chromebox, and there's an SD/MMC card reader on the left-hand side as well.

Its tiny size means it can fit almost anywhere: on a desk, on the back of a monitor or even in your media cabinet if you fancy a dedicated web-browsing PC for your TV

There's also built-in dual-band 802.11n Wi-Fi and Bluetooth 4.0.

You also get a wireless keyboard and mouse set included in the box, although the two peripherals require a USB dongle and don't take advantage of the Chromebox's Bluetooth connectivity. This means one of the four USB3 ports is permanently occupied, which seems a bit of a waste. Still, the mouse, while comically small, is reliable and comfortable to use. The keyboard, meanwhile, has a childlike feel to it and won't suit quick typists. What's more, the slightly odd dimensions mean some of the keys feel out of place, which takes a fair amount of time to get used to. The keyboard also replaces the entire top row of F-keys with Chrome OS-specific



functions, including window management, browser navigation, audio controls and, oddly for a desktop PC, brightness controls.

## OVERHEAD PROJECTOR

Of the several available specifications, including a rather excessive £500+ Intel Core i7 version, we reviewed the more reasonably priced £209 Celeron model. Despite the leisurely 1.4GHz clock speed of the dual-core Celeron 2955U, performance is assisted by the lightweight Chrome OS operating system and 4GB of RAM. With very little overhead, the processor is able to put all of its effort into the things you're doing in the foreground. With very little going on elsewhere, image-

If you'll be storing files locally, you'll need an SD card, as you get only 16GB of dedicated storage. Using the Chromebox for large local files would be missing the point of Chrome OS, though, which is much more suited to online content and web applications.

It is possible to use the Chromebox like a traditional desktop PC, although some recent updates have changed Chrome OS for the worse. The once simple app selection and search menu that opened in the bottom-left of the screen now opens dead-centre and can't be moved, and features a Google search bar and large Google Now cards, making accessing shortcuts for web apps more difficult. It's an unnecessary complication to what was a fairly usable system in the past.

## BARGAIN HUNT

The Asus Chromebox is a bargain mini-PC, undercutting its Windows-powered rivals in terms of price while still offering capable performance and reasonable specifications. There are limitations with an operating system that's so reliant on web content, but since it's so easy to get a large amount of your computing done online, the trade-offs of switching to Chrome OS are nowhere near as severe as they once were. It's not going to be for everybody, but if your demands are modest and you're willing to start moving your work and personal life to the cloud, the Chromebox is a great way to do so.

If you have more money to spend and want a PC capable of doing a little more for your media, consider the Acer Revo RL85 (Reviews, Shopper 330), a tiny PC with a huge amount of room for internal storage for £400.

Michael Passingham

## SPECIFICATIONS

**PROCESSOR** Dual-core 1.4GHz Intel Celeron 2955U • **RAM** 4GB • **FRONT USB PORTS** 2x USB3 • **REAR USB PORTS** 2x USB3 • **TOTAL STORAGE** 16GB SSD • **GRAPHICS CARD** Intel HD Graphics • **DISPLAY** None • **OPERATING SYSTEM** Chrome OS • **WARRANTY** One year collect and return • **DETAILS** [www.asus.com](http://www.asus.com) • **PART CODE** Chromebox-M031U





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## BUDGET DESKTOP PC

# ACER Extensa EM2610



£424 inc VAT • From [www.dabs.com](http://www.dabs.com)

### VERDICT

A cheap desktop PC with occasionally stuttery performance, meagre storage and no USB3 ports

**WE RARELY REVIEW** desktop PCs from larger manufacturers, as we typically find that mid-range to high-end gaming PCs are often served better by the UK's system integrators, who can provide a personal service and hardware customisation as well as decent performance and a good warranty. There's still room for the big boys to butt in, though.

You'd expect the likes of Acer to be able to offer low-end PCs for a good price, because they buy and sell in such vast quantities. The Extensa EM2610 is the most basic desktop computer we've reviewed in months, but for the modest home or small business user who wants a traditional desktop experience without being saddled with an expensive all-in-one or measly NUC-style device, its on-paper specifications look good enough.

One thing big manufacturers manage to keep unique are their chassis. While smaller system integrators buy off-the-shelf cases you can find anywhere, the big companies stamp their own style on every PC they make. It would be misleading to call the EM2610 stylish, but it's not ugly. The perforated front panel and boxy design is understated and won't look out of place on a desk. The microATX form factor means it has a small footprint, so will fit in spaces a traditional tower can't.

### PORTS REPORT

Practicality is an issue with the ports on this machine: it has no USB3 ports, so file transfers from USB sticks will be lethargic. While budget is key here, the lack of USB3 provision is stingy. There is at least space for plenty of peripherals, with two USB ports on the front and four more on the rear. There's

also a DVD-RW drive, something that's becoming increasingly rare on modern PCs.

Intel Core i5 processors offer fantastic performance for a reasonable price, and we saw some evidence of that in our multimedia tests. The PC flew through the image-editing test with a score of 99, which is exactly what we'd expect. The 85 it managed in the video-rendering test was a little lower than we'd expected from the quad-core, 3.2GHz Core i5-4460 chip, but it was in the multitasking test that things fell apart. This test requires the PC to convert images and video while also playing an Ultra HD movie on a loop. Typically, we'd expect a score in the 80s from a desktop PC with a dedicated graphics card, but the EM2610, with its integrated Intel HD Graphics 4600, could manage only a disappointing 58, bringing its overall score down to 74.

We can't fault the EM2610 for its lack of a graphics card; it's a budget PC built primarily for work, after all. The motherboard supports two external displays, with a DVI and a VGA port catering for two Full HD monitors for better multitasking. This isn't a gaming PC, so 3D performance shouldn't be a consideration. We ran our Dirt Showdown benchmark on the PC for the sake of completeness, but the woeful 2fps result came as no surprise.

We noticed occasional hangs and stutters, often when attempting to work at the same time as copying files from a USB stick. This may be down to the cheap and rattly Seagate Barracuda 500GB hard disk, which isn't particularly fast. If you open lots of programs at once, you may also start to run low on memory; only a single 4GB stick of RAM is provided. There's a second slot on the motherboard, though, so if you want to double your memory, you can.

There's a little room for expansion elsewhere, too. The Acer H81H3-AM motherboard has a free PCI-E x16 (2nd gen) slot, so if you wanted to improve multimedia performance on a budget you could install a graphics card. You'll be restricted to cheap, bus-powered cards, however, as there are no spare power connectors coming from the meagre 220W PSU.



There are two PCI-E x1 slots for smaller add-ons such as a wireless cards or a set of PCI-E USB3 ports, and there's also a legacy PCI slot at the bottom of the motherboard. The power supply, motherboard and case can accommodate a second hard disk if you want to expand your storage.

### OPEN WINDOWS

The PC ships with Windows 7 and includes a Windows 8.1 licence, plus you can upgrade to Windows 10 for free within a year of the OS's release. It also comes with an Acer-branded mouse and keyboard set, both of which are usable, though the keyboard is a little spongy.

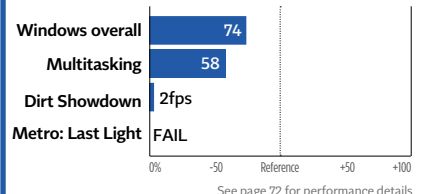
The Extensa EM2610 is a budget PC that makes no effort to disguise this fact. Stuttery performance, a noisy hard disk and a lack of USB3 ports means we can't recommend it, even if, on the face of it, it looks a bit of a bargain. You can do much better for around £50 more with the PC Specialist Fusion Gamer Lite (Shopper 325), or £77 more with the Palicom Kaveri Evolution (Shopper 316).

*Michael Passingham*



### SPECIFICATIONS

**PROCESSOR** Quad-core 3.2GHz Intel Core i5-4460 • **RAM** 4GB • **FRONT USB PORTS** 2x USB • **REAR USB PORTS** 4x USB • **TOTAL STORAGE** 500GB hard disk • **GRAPHICS CARD** Integrated Intel HD Graphics 4600 • **DISPLAY** None • **OPERATING SYSTEM** Windows 7 • **WARRANTY** One year RTB • **DETAILS** [www.acer.co.uk](http://www.acer.co.uk) • **PART CODE** DT.XOCEK.003





## ULTRA-PORTABLE LAPTOP

# CHILLBLAST Helios



£700 inc VAT • From [www.chillblast.com](http://www.chillblast.com)

### VERDICT

The Chillblast Helios packs decent performance into a compact chassis but its touchpad infuriates

**THERE'S A LOT** to like about the travel-friendly Chillblast Helios. It will happily slip into a laptop bag or rucksack without weighing you down at 1.4kg, and the tapered design is 18mm at its thickest point, which is just a fraction thicker than the MacBook Air.

Comparisons with Apple's ultra-portable laptop are almost unavoidable, as the designs are similar at a cursory glance. Like the Air, the Helios uses an aluminium chassis that cuts down on weight and helps make the laptop feel like a premium product in your hands. The edges are a little sharp, but overall the chassis has respectable build quality and is generally pleasant to the touch.

It's a little plain, with matt silver used throughout and just a Chillblast logo stuck on the lid, though the silver has a slight speckled design upon closer inspection. There's a bank of white LED status indicators above the keyboard, but they aren't visible with the lid closed so you can't tell if the laptop is active.

### MATT'S THE WAY TO DO IT

The 14in display has a 1,920x1,080 resolution and a matt coating that helps cut down on screen reflections. Glossy screens provide higher contrast, but we found the matt coating easier on our eyes when working in direct sunlight. Our colour calibrator showed that the display's performance was very respectable; while black levels of 0.37cd/m<sup>2</sup> aren't quite as deep as we would like, peak whites of 360.8cd/m<sup>2</sup> are much better.

Contrast is also decent at a ratio of 970:1, and while 89% sRGB colour gamut coverage won't make the Helios the best choice for colour-sensitive work, colours are still punchy and vibrant. There's no noticeable backlight bleed, and both horizontal and vertical viewing angles are very good.

The dual-core Intel Core i5-5200U inside the Helios runs at 2.2GHz, but can boost to 2.7GHz under the right thermal conditions.

Our tough benchmarks, which are based around 4K video transcoding, caused the dual-core processor to struggle, even with 8GB of RAM, but a score of 75 is still respectable.

In part, performance is limited by the ultra-portable design, but we were still able to edit 1080p videos and Windows always felt responsive. For day-to-day tasks, the Helios is a great performer. Its responsiveness, snappy boot times and application launch speeds are aided by the 250GB Samsung 850 Evo SSD. The Helios comes with an M.2 SSD as standard but you can also add a secondary 2½in SSD or SSHD if you want additional storage.

Battery life is one of the Helios' strongest elements, with an impressive 9h 18m in our tests, so it will get you through a whole day before you're searching for a power outlet.

### LOSING TOUCH

An infuriating touchpad lets the Helios down. It's a decent size and its coating is pleasant to touch, with a decent amount of resistance. However, tap to click is incredibly inconsistent. Sometimes taps would register, but more often than not they wouldn't.

The entire touchpad can be pressed in to register a click, but this requires far more force than a tap. There are no separate left and right buttons either, and we occasionally right-clicked when looking to left-click. Having to forcibly press the touchpad down to register a click also makes clicking and dragging gestures unwieldy, making editing video content particularly laborious. Two-finger scrolling is also inconsistent and we

immediately had to connect a USB mouse.

There is at least a generously sized palm rest, and the keyboard is comfortable to type on. The chiclet keys are nicely spaced and each key press has a good amount of travel. The only annoyance we had was the second Fn modifier key on the right side, which means the right Shift key is smaller than usual. There's negligible flex to the chassis around the keyboard, too, which helps considerably with typing comfort.

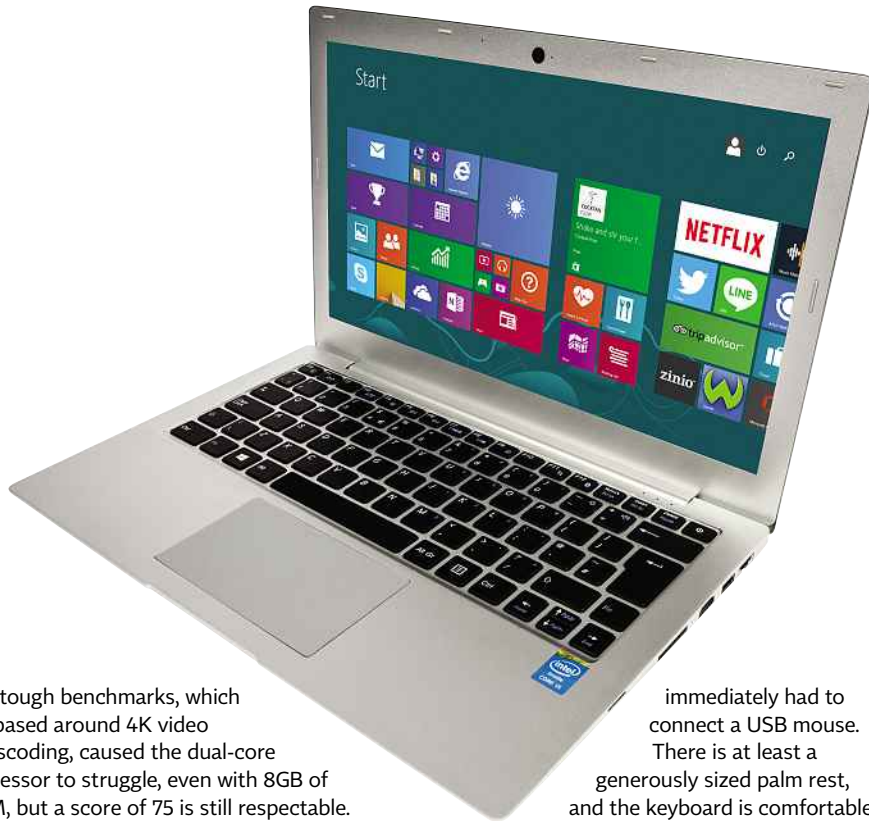
### CONNECTION POINTS

There are just two USB ports on the Helios, only one of which is the faster USB3, which is a little limiting but excusable due to the Helios' thin form factor. Otherwise there is an HDMI output, Ethernet port, SD card reader and a headphone and microphone jack.

As well as the Ethernet port for wired networking, there's 802.11ac Wi-Fi built-in, which will be useful if you have a router that supports the faster wireless standard. The wireless card is an Intel Wireless-AC 3160, which only supports up to 433Mbit/s throughput but will still be faster than the 802.11n Wi-Fi we often still see with laptops.

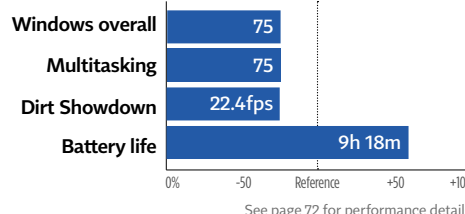
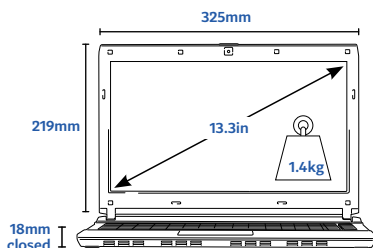
The Chillblast Helios is a well-specified and decent-performing ultra-portable for the money. Its construction and build quality is admirable. However, its touchpad makes using it laborious. If you're looking for an ultra-portable, the Asus ZenBook UX303LA is a good choice and costs the same.

*Richard Easton*



## SPECIFICATIONS

**PROCESSOR** Dual-core 2.2GHz Intel Core i5-5200U • **RAM** 8GB • **SIZE** 325x219x18mm • **WEIGHT** 1.4kg • **SCREEN SIZE** 13.3in • **SCREEN RESOLUTION** 1,920x1,080 • **GRAPHICS ADAPTOR** Intel HD Graphics 5500 • **TOTAL STORAGE** 250GB SSD • **OPERATING SYSTEM** Windows 8.1 • **PARTS AND LABOUR WARRANTY** Two years collect and return, three years labour • **DETAILS** [www.chillblast.com](http://www.chillblast.com) • **PART CODE** Helios i5 5200U



## HYBRID LAPTOP

# HP Elite X2 1011 G1



£894 inc VAT • From [www.dabs.com](http://www.dabs.com)

### VERDICT

A well-constructed business-focused hybrid with fantastic battery life

**TRANSFORMING TABLETS/LAPTOPS** are popular for a reason: people want the convenience of a tablet and the productivity of a laptop without having to buy both. Hybrids are now a dime a dozen, but few are aimed at business users. The HP Elite X2 1011 G1 is one of those few.

It's enterprise-friendly, with a biometric fingerprint sensor to provide security above that of a standard password, a smartcard reader built into the detachable Power Keyboard, an integrated Trusted Platform Module and a suite of HP management applications. Signing into Windows is particularly satisfying, with just a simple swipe across the fingerprint reader located below the keyboard taking us to the desktop.

The Elite X2 can be used as an 11.6in tablet or, when docked to its Power Keyboard, as a fully fledged laptop. Using the Power Keyboard has the added benefit of supplementing the tablet's 2-cell battery with an additional 6-cell battery for extra longevity. With the two components combined, the Elite X2 lasted an excellent 12h 36m in our tests, so it will easily get you through the working day.

### THE THICK OF IT

It isn't the most compact tablet at over 10mm thick, nor is it the lightest at 870g. The 11.6in screen means it's also slightly awkward to hold, and is far from being a one-handed device. The Power Keyboard makes the overall package twice as thick at 21mm, but at just 1.65kg combined the Elite X2 is still reasonably light for an ultra-portable laptop.

Tablet and keyboard dock together quickly and simply using magnets and clips. The two components are evenly weighted, so there's no chance of the laptop tipping backwards, and it feels nice and secure, letting you pick it up by the screen. We were a little worried the Power Keyboard was obscuring the front-facing stereo speakers at the bottom of the

tablet, but we couldn't hear a noticeable difference in sound quality while the tablet was docked. Sound quality is respectable but tinny, as it is with most tablets.

The tablet is powered by an Intel Core M-5Y51 processor that runs at 1.1GHz, but can Turbo Boost to 2.6GHz. Performance in our multimedia benchmarks was respectable, with a score of 79, but the Elite X2 is unsurprisingly better suited to day-to-day office-based tasks. You may find it will begin to struggle under more processor-intensive tasks such as video editing, even with its 8GB of RAM.

### BLACK MARKS

We found the Elite X2's display to be a little disappointing. It has a 1,920x1,080 resolution and has perfectly acceptable brightness at 384.7cd/m<sup>2</sup>, but black levels are below par at 0.45cd/m<sup>2</sup>. Colour accuracy is disappointing, at just 63.5% coverage of the sRGB colour gamut, making the device a poor choice work that requires a degree of colour accuracy. Viewing angles are at least respectable.

There's not much connectivity on the tablet, with just a docking connector and a headphone jack on the bottom that is only exposed when the tablet is undocked from the keyboard. There's another headphone jack on the keyboard for when they're connected. There's also a SIM card slot for the 4G modem and a microSD expansion slot. The Elite X2 has a 256GB M.2 SSD installed, so there's already plenty of storage out of the box. A Wacom stylus is also hidden away in the bottom of the tablet, giving you another way to interact with the screen.

With no other connections on the tablet, there's no way to charge it independently of the Power Keyboard. This means

you can't carry the tablet around separately from the keyboard in case the battery runs out while on the road.

Chances are you'll be carrying the Power Keyboard with you anyway, as it holds most of the connections. There are two USB3 ports, which is generous for a hybrid laptop, as well as a DisplayPort connection for an external monitor. There's also a proprietary HP dock connector that can be used with an optional Ethernet and VGA adaptor (£36 inc VAT from [store.hp.com](http://store.hp.com)). The Elite X2 also has fast 802.11ac Wi-Fi and Bluetooth 4.0 connections.

### KEY WORKER

The backlit keyboard is comfortable to type on, although the occasional keystroke was missed because of the small keys. The HP Forcepad touchpad is also pleasant to use; it's a generous size and uses pressure sensitivity to register clicks. We found it fiddly to use, however, preferring the conventional tap-to-click instead. Of course, you also have the option of using the touchscreen.

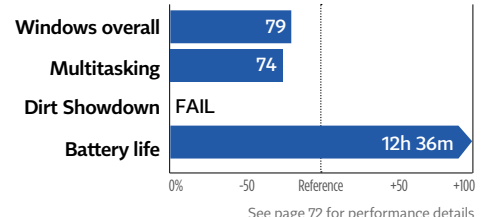
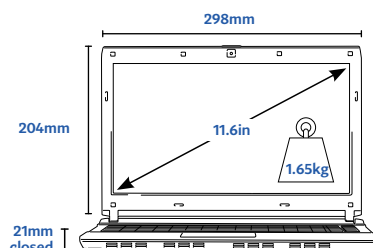
If you're after a business-focused hybrid laptop, the Elite X2 1011 G1 has plenty of office-friendly credentials. Display quality is the only real blemish on an otherwise capable machine. It's a great choice for a run-all-day work laptop, but if you'll be spending more time in tablet mode consider the cheaper Microsoft Surface 3 (Shopper 330) instead.

*Richard Easton*



## SPECIFICATIONS

**PROCESSOR** Dual-core 1.1GHz Intel Core M-5Y51 • **RAM** 8GB • **SIZE** 298x204x21mm  
• **WEIGHT** 1.65kg • **SCREEN SIZE** 11.6in •  
**SCREEN RESOLUTION** 1,920x1,080 •  
**GRAPHICS ADAPTOR** Integrated Intel HD Graphics 5300 • **TOTAL STORAGE** 256GB SSD • **OPERATING SYSTEM** Windows 8.1 Pro • **WARRANTY** Three years RTB •  
**DETAILS** [www.hp.com](http://www.hp.com) • **PART CODE** L5G47EA





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## MID-RANGE SMARTPHONE

### EE Harrier

★★★★★

£200 inc VAT • From www.ee.co.uk

#### VERDICT

With its Full HD display, relatively fast internals and decent camera, the EE Harrier is a great phone on PAYG, but isn't such good value on contract

**AS LAST YEAR'S** Kestrel prepares to fly the coop, EE's own-brand handsets now have a new pecking order for 2015. Ruling the roost is the £200 Harrier, but it's also joined by the smaller £100 Harrier Mini. Both phones look almost identical: each has a grey metallic finish and yellow highlight ring on the rear camera to give a bit of character, and both run vanilla Android 5.0.2, which makes a nice change from Huawei's Emotion UI on the outgoing Kestrel.

The 5.2in Harrier has a higher-resolution screen, faster processor, bigger battery, more storage and a better rear camera than the Mini. It's also a fraction slimmer, measuring 8.9mm compared to the Mini's 9.5mm. It's a small difference overall, but it does give the Harrier a slightly more upmarket feel.

It's not often we see a 5.2in, 1,920x1,080 display on a £200 phone. This gives the Harrier a massive pixel density of 424ppi. Image quality doesn't hit quite the same heights, but we were still impressed by an sRGB colour gamut score of 88.2%. This puts the Harrier roughly on par with Motorola's 2nd Gen Moto G, and while red coverage was a little lacking, our test images still had plenty of punch.

A contrast ratio of 900:1 ensures plenty of detail is present at a variety of angles and a peak brightness of 383.17cd/m<sup>2</sup> is just about high enough to see the screen clearly in bright sunshine. A high black level of 0.42cd/m<sup>2</sup> meant detail was lost in darker areas of images, but it's certainly no worse than other £200 handsets we've tested.

#### HARRIER JUMP JET

The Harrier is much faster than its similarly priced competitors, with an octa-core, 1.7GHz Qualcomm Snapdragon 615 processor and 2GB of RAM – the same chip used by HTC's £260 Desire 820. This translated into fast app-loading times, and we didn't have to wait long for the Settings menu to open. A score of 737 in Futuremark's Peacekeeper browser test isn't far behind the LG G4's 818. The Harrier showed only a minimal amount of stutter as pages loaded up on complex news sites such as the *Guardian*. Otherwise, scrolling is smooth and lag-free, and images load very promptly.

It may only produce 370 frames in GFX Bench

GL's incredibly demanding onscreen Manhattan test and 350 frames in the offscreen test, equating to about 5fps, but other mid-range phones produce roughly the same scores. A quick game of Blizzard's Hearthstone showed the Harrier is more than capable of handling games without too much judder.

The 2,500mAh battery lasted an impressive 10h 40m in our continuous video playback test with the screen set to 170cd/m<sup>2</sup>. This compares well with its rivals, beating the HTC Desire 820 and One M9 by more than an hour.

We're pleased to see EE has kept the number of pre-installed apps to a minimum. The irritating full-screen widgets can be removed, and everything you need as an EE customer is found inside the My EE app. This lets you check how much data, minutes and texts you have left each month, as well as top up, buy add-ons and access the EE store. EE's recently launched Wi-Fi calling service, which lets you make and receive calls over Wi-Fi if your signal drops, will be available to use directly from the dialler later this summer.

#### KEEP THE NOISE DOWN

The Harrier's 13-megapixel camera is decent for a £200 phone. Colours were a tad muted in our outdoor shots, but plenty of detail was present and only large areas of sky showed any obvious signs of noise. Zooming in at full resolution revealed grainy textures and harsh edges, but this is a minor complaint. We wouldn't recommend shooting in HDR, though, as this actually reduced the amount of detail by blurring finer areas of brickwork together, and shadows looked unnaturally bright.

Indoors, the Harrier coped well when there was plenty of light present, but turning off our external lamp quickly made objects look blurry and riddled with extra noise. Turning on the flash helped slightly, but our white background still looked very grey and noise was present throughout.

At £200 on pay-as-you-go, the EE Harrier is great value. It offers a lot more than the 2nd Gen Moto G for only £50 more, and you won't find anything faster for the money. Contracts are quite expensive, though, as the cheapest starts at £22 a month for 500MB of 4G data, 500 minutes and unlimited texts. For only a few more pounds each month, you can get a Samsung Galaxy S5, which trumps the Harrier in almost every way. The Harrier is a good buy on PAYG, but those buying on a contract should look elsewhere.

Katharine Byrne



#### SPECIFICATIONS

**PROCESSOR** Octa-core 1.7GHz Qualcomm Snapdragon 615 • **SCREEN SIZE** 5.2in • **SCREEN RESOLUTION** 1,920x1,080 • **REAR CAMERA** 13 megapixels • **STORAGE** 16GB • **WIRELESS** DATA 3G, 4G • **SIZE** 147x74x8.9mm • **WEIGHT** 145g • **OPERATING SYSTEM** Android 5.0.2 • **WARRANTY** One year RTB • **DETAILS** www.ee.co.uk • **PART CODE** EE Harrier

Battery life



See page 72 for performance details



## METAL-FRAME SMARTPHONE

# SAMSUNG Galaxy A5



£270 inc VAT • From [www.expansys.com](http://www.expansys.com)

### VERDICT

An AMOLED screen, excellent camera and long battery life, but poor performance lets the pricy Galaxy A5 down

**AS THE MIDDLE SIBLING** in Samsung's trio of metal mid-range smartphones, the Galaxy A5 shows you don't need to splash out on an expensive flagship handset to enjoy excellent build quality and top-of-the-range design.

A 5in, 1,280x720 resolution Super AMOLED display makes the A5 easier to handle than the super-sized Galaxy A7, and the higher-resolution screen is better for web browsing than the compact Galaxy A3. It's a lot more attractive than other mid-range smartphones we've seen recently, such as the plastic HTC Desire 820, and we like how the glitter finish on the rear shimmers when it catches the light.

Samsung has managed to fit everything inside a svelte 6.7mm, 123g handset; that's thinner than both the Galaxy S6 and S6 Edge, albeit only by 0.1mm and 0.3mm respectively. It gives the A5 the look and feel of a top-flight smartphone without the eye-watering prices.

The A5 shares the same screen lineage as its top-end cousins, with Samsung's Super AMOLED panel technology giving the 5in, 1,280x720 resolution display plenty of punch. Its maximum brightness level of 347.26cd/m<sup>2</sup> isn't as bright as a typical LCD screen, but the A5's colour accuracy is top of its class, as our colour calibrator returned a perfect sRGB colour gamut score of 100%. Colours are rich and vibrant and blacks incredibly deep at 0.00cd/m<sup>2</sup>, which helps text really stand out against white backgrounds.

### QUITE A CONTRAST

Contrast levels are also extremely high, so much so that our calibrator couldn't even give us a score, so you should find plenty of detail in photos and videos. The 1,280x720 resolution gives most web pages enough definition, although you'll still have to zoom in occasionally to read smaller text on desktop sites.

The big, high-res screen doesn't come at the cost of battery life, with the A5's 2,300mAh battery lasting an excellent 15h 18m in our continuous video playback test with the screen set to 170cd/m<sup>2</sup>. That's almost an hour more than the Galaxy A3 and just over ten minutes shy of the S6 Edge, so you'll get plenty of use over the course of a day.

It's the quad-core, 1.2GHz Qualcomm Snapdragon 410 processor that betrays the A5's mid-range aspirations, however. This is not only the same processor powering the cheaper Galaxy A3, but the one you'll find in the £110 2nd Gen

Motorola Moto E. While this is just about acceptable in the £220 Galaxy A3, we would expect to see something a bit faster, such as the Snapdragon 615, in the £270 A5.

It leaves the A5 feeling sluggish for the price. Geekbench 3 scores of 481 and 1,431 in the single and multicore tests are almost identical to the Moto E's, and graphics performance isn't any better. The A5 and Moto E produced an identical 112 frames in the offscreen Manhattan test in GFX Bench GL 3.0.

It's still fast enough to run Android 4.4.4, as menu animations were smooth and apps loaded relatively quickly. However, it can often

The A5's colour accuracy is top of its class, with our colour calibrator returning a perfect sRGB colour score of 100%

take a while to switch back and forth between the A5's full-screen Flipboard widget, and web pages often take several seconds to load.

Even when pages have loaded, scrolling up and down articles can be very stop-start, and overall performance isn't as snappy as we'd expect from a phone of this price. This was reflected in the A5's Peacekeeper browser test score of just 685, a long way off similarly priced phones such as the £280 HTC Desire 820's 1,138, or the £300 Honor 6 Plus, which scored 1,164. Android 5 Lollipop is promised soon, but it's unclear whether the phone will be powerful enough to run the new OS smoothly.

### RICH PICKINGS

The 13-megapixel rear camera produced some splendid-looking outdoor shots. Colours were rich and images full of clean, crisp detail. Like the Galaxy A3, it didn't fare so well when faced with direct sunlight, but it nevertheless did an admirable job of balancing the light and dark areas of each photo under these challenging lighting conditions. If you do find yourself caught in the sun, switching to HDR mode lightens areas of shadow considerably and eliminates the vast majority of crushed whites.

Pictures were equally impressive indoors, regardless of how much light



was available. Colours were both rich and vivid with and without our external lamp switched on, and we were particularly pleased with how little noise and compression we saw along the plant stems in our still-life composition when the lamp was turned off. The camera definitely punches above its weight given the price.

The Galaxy A5 is a beautifully designed handset with almost all the hallmarks of a great mid-range smartphone. It has a great camera, excellent battery life and high-quality screen, but its sub-par processor really lets it down. We'd simply expect more at this price, especially when you can get the infinitely superior Galaxy S5 for the same money on a £25.50-per-month contract.

We like the A5, but compared to its more sprightly brethren, it's the awkward middle child of Samsung's new A series.

Katharine Byrne

### SPECIFICATIONS

**PROCESSOR** Quad-core 1.2GHz Qualcomm Snapdragon 410  
**SCREEN SIZE** 5.0in • **SCREEN RESOLUTION** 1,280x720 •  
**REAR CAMERA** 13 megapixels • **STORAGE** 16GB •  
**WIRELESS DATA** 3G, 4G • **SIZE** 139x70x6.7mm •  
**WEIGHT** 123g • **OPERATING SYSTEM** Android 4.4.4 •  
**WARRANTY** One-year RTB • **DETAILS** [www.samsung.com/uk](http://www.samsung.com/uk) • **PART CODE** SM-A500FU



See page 72 for performance details

# SONY Xperia M4 Aqua

COMPUTER  
SHOPPER  
RECOMMENDED

★★★★★

£225 inc VAT • From [www.expansys.com](http://www.expansys.com)

## VERDICT

The camera could be better, but the Xperia M4 Aqua has the build quality and speed to put its rivals to shame

**MID-RANGE SMARTPHONES** have had something of a reinvention in the past couple of months. Instead of overpriced plastic slabs, we've seen metal beauties such as Samsung's Galaxy A3 and Galaxy A5, and the EE Harrier shows you don't have to pay over the odds to get a fast chipset. This all gives the Xperia M4 Aqua some pretty decent competition, but Sony's latest is more than up to the challenge.

The Xperia M4 Aqua riffs off Sony's flagship Xperia Z3 almost note for note; it's rated IP67/68 water- and dust-resistant and uses a near identical unibody metal frame with a glossy glass rear. We were big fans of the Xperia Z3's design when it launched last year, so we're pleased to see its curved metal frame and nylon-protected corners making a comeback in a mid-range phone. The result is a seriously stylish-looking handset, and the red coral variation is particularly gorgeous. We much prefer it to the flat, angular lines of Samsung's Galaxy A3 and Galaxy A5.

The phone can be immersed in up to a metre of water for 30 minutes. This has long been a staple of Sony's flagship devices, so it's great to see this feature in a mid-range phone. You won't have to make sure the USB port is sealed off each time you want to check Twitter in the bath, either, as the Xperia M4 Aqua has a capless USB port. Just make sure you dry the touchscreen, as it's difficult to use accurately when wet.

## COLOUR ME BAD

The 5in M4 Aqua might have a much bigger screen than the similarly priced Galaxy A3, but sRGB colour accuracy was a disappointingly low 86.2%, which is roughly the same as the £140 Xperia M2. Red coverage was by far its weakest point. It showed in our test images, as colours looked noticeably cooler than the M2. However, while colours don't necessarily have a lot of punch, whites are much cleaner and a high peak brightness of 534.28cd/m<sup>2</sup> makes the phone very versatile, whether you're indoors or out in the sunshine.

The downside is that blacks aren't particularly deep, as we measured a black level of 0.72cd/m<sup>2</sup>, which is the highest score we've ever recorded. Even the Xperia Z3, which had a higher maximum brightness of 592.19cd/m<sup>2</sup>, managed to keep blacks down to 0.52cd/m<sup>2</sup>, so to see the M4 Aqua go even higher is disappointing. This means that text may have a tendency to look quite grey, but at least the screen's contrast ratio of 735:1 means you'll still see plenty of detail.

A 1.5GHz octa-core Qualcomm Snapdragon 615 processor and 2GB of RAM feels like a breath of fresh air compared to the slower Snapdragon 410 found in the Samsung Galaxy A3 and Galaxy A5. This chipset is much more befitting for a £225 handset, and the difference was plain to see in both our benchmark scores and day-to-day use. Geekbench 3 scores of 638 in the single core test and 2,427 in the multicore test weren't far off the LG G4, which scored 692 and 2,547.

Equally outstanding was its Peacekeeper browsing test score of 839, which actually beats the LG G4 and is just behind the Huawei P8, which scored 849. It's also faster than other phones we've seen with the Snapdragon 615 chipset: the EE Harrier scored just 737 while the HTC Desire 820 scored 799. In practice, web pages load quickly and scrolling down image-heavy web pages feels extremely fast and smooth. Graphics performance is good, too, with 752 frames in the demanding onscreen Manhattan test in GFX Bench GL 3.0 (which equates to roughly 12fps) and 362 frames (or 5.8fps) in the offscreen test.

## STAYING POWER

The M4 Aqua can't match the Galaxy A3 when it comes to battery life, but its 10h 16m in our video playback test with the screen set to 170cd/m<sup>2</sup> is still pretty decent. The 2,400mAh battery should also last for up to two days with the phone left in Stamina mode, which will be useful when you're in a pinch, although as it restricts hardware performance you'll only want to use it when you really have to.

Outdoors, we were pleased with how the M4 Aqua's 13-megapixel camera coped with bright sunshine, as images were well exposed with only a few areas of blinding white clouds. However, every shot we took in Superior Auto mode produced very cool-looking colours, almost as if there were a blue sheen covering the entire image. The situation didn't improve in Manual mode or with HDR enabled, either. Exposure levels were impressive, but the pale colour cast was arguably more noticeable.

Oddly, colours looked more natural and accurate in our still life than they did outside and there was plenty of detail present, even with our external lamp turned off. We could still see some compression and noise around



the stems of flowers, but textures were crisp and text in our poster was clear and legible.

Our only other major grievance with the M4 Aqua is its pitiful amount of onboard storage. Only 4GB is actually available to the user from its claimed 8GB. This is stingy for a £225 phone, but at least you can add a microSD card to expand up to 128GB.

## AQUA FRESH

The camera may be slightly flawed, but there's still plenty to like about the Xperia M4 Aqua. It's fast, easily outstripping the Samsung Galaxy A3 and Galaxy A5. Samsung wins on screen quality, but the M4 Aqua has the edge when it comes to price; it costs the same as the smaller 4.5in Galaxy A3 SIM-free, but is cheaper on contract, with prices starting at £15 per month, as opposed to the Galaxy A3's £17-per-month contract with a £30 up-front cost. The Galaxy A3 is a good choice if you want a more compact handset, but if you're looking for something a little bigger, the Sony Xperia M4 Aqua is the next best alternative.

Katharine Byrne

## SPECIFICATIONS

**PROCESSOR** Octa-core 1.5GHz Qualcomm Snapdragon 615 • **SCREEN SIZE** 5in • **SCREEN RESOLUTION** 1,280x720 • **REAR CAMERA** 13 megapixels • **STORAGE (FREE)** 8GB (4GB) • **WIRELESS DATA** 3G, 4G • **SIZE** 146x73x7.3mm • **WEIGHT** 136g • **OPERATING SYSTEM** Android 5.0.2 • **WARRANTY** One year RTB • **DETAILS** [www.sonymobile.com/gb](http://www.sonymobile.com/gb) • **PART CODE** E2303





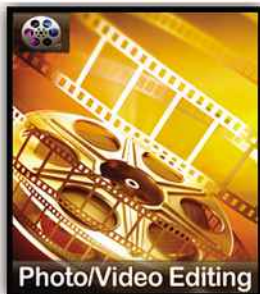
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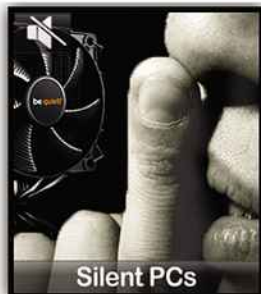
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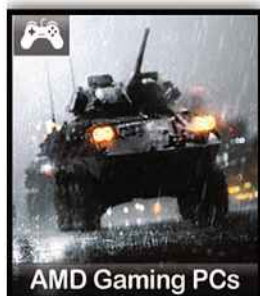
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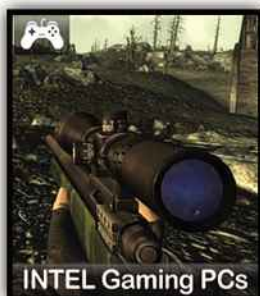
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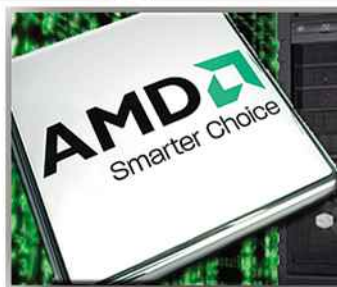
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AMAZON

## Kindle Paperwhite (2015)

COMPUTER SHOPPER

★★★★★

BEST BUY

£120 inc VAT • From [www.amazon.co.uk](http://www.amazon.co.uk)

## VERDICT

An upgraded display makes this the best-value Kindle yet, but there are strong alternatives to Amazon

**ANOTHER YEAR, ANOTHER** Kindle update. This time it's the Amazon Kindle Paperwhite that's getting an overhaul, but while such updates often amount to little more than a processor upgrade or some tinkering with contrast levels, Amazon has gone much further here. The new Paperwhite, or Paperwhite 2015 if you prefer, has had its display upgraded from 212 to 300 pixels per inch, putting it alongside Amazon's flagship Kindle Voyage in terms of resolution.

As far as we can tell this is the same 6in E-Ink Carta display in the Voyage, for almost £50 less. It's the same display as the £110 Kobo Glo HD (see *Reviews*, *Shopper* 331), putting Amazon and its rival on roughly level pegging when it comes to displays and prices.

The new Paperwhite looks almost identical to the first two models, dating back to 2012, with just a few small changes to logo placement and colour. The rubbery rear panel is a little more matt in its finish and a little more fingerprint-resistant. The basic curved-off all-black design remains intact.

The Paperwhite is bigger and heavier than the Kobo Glo HD. The Kobo is as thick, but

The one remaining annoyance is the lack of an ambient light sensor. This means you have to set the brightness manually, which feels decidedly retro when every phone and tablet now does this automatically. The Kindle Voyage has a built-in light sensor, which slowly dims as your eyes adjust to the dark, but it's not enough to justify the extra price.

Text is noticeably crisper than on the old Paperwhite, though it's not a huge upgrade. Amazon's new Bookerly font, which is designed specifically for eReaders, is less chunky than the old default Caecilia font, and has some nice touches that become apparent at larger sizes. This font hasn't yet been rolled out to older models, though it will be shortly.

With the new font, higher-resolution screens and better contrast, we're now happy

## As well as making it easier to read in the dark, the built-in light also improves contrast in almost any lighting conditions

slightly narrower and much shorter. The differences aren't huge but the Kobo feels more comfortable to hold in one hand.

The new display is very sharp; we can't see anyone ever needing more pixels than this from a 6in eReader. Amazon is still using a slightly textured screen finish, which feels like running your finger across a coarse piece of paper; we prefer the Kobo's smooth finish, but it's really down to personal preference.

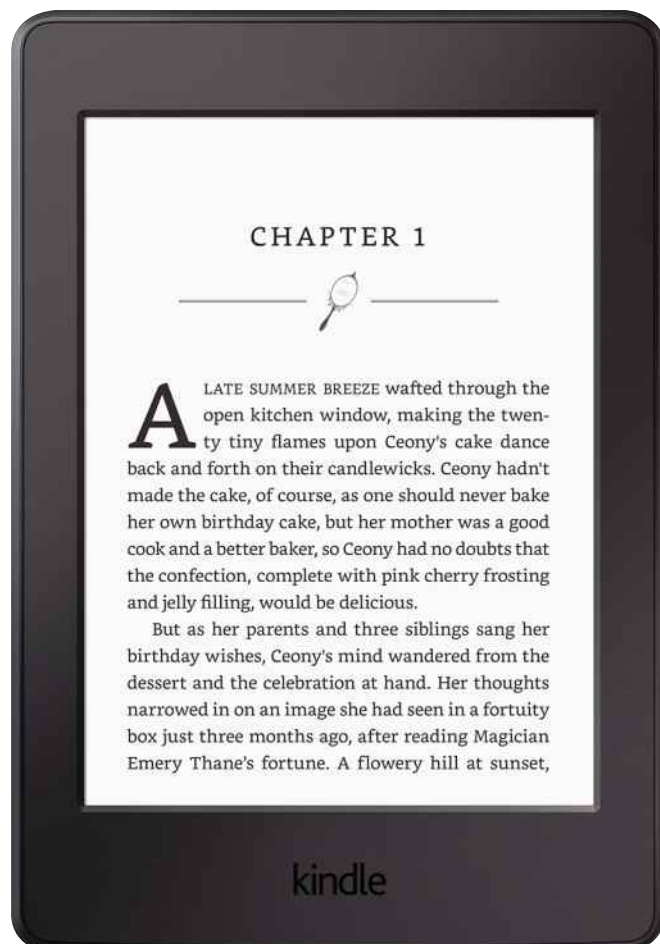
## LET THERE BE LIGHT

For those coming from a pre-2012 Kindle, the built-in light (which looks like a backlight but is technically more of a sidelight) is as much of a boon as the increased resolution. As well as making it easier to read in the dark, it also improves contrast in almost any lighting conditions. The light is consistently even and, while we could discern a subtle shadow at the bottom edge of the screen at maximum brightness, it's not an issue in general use.

to pack more words on to a page. However, Amazon's font size options are still limited, with eight sizes in total and only two we'd use. Amazon needs to introduce finer graduations, so you can choose the exact size you want.

Amazon also has a new typesetting engine, which is designed to solve the long-running issue of its eReaders justifying text across a whole line. This means words line up with the near and far edges of the line, but spaces are littered throughout the text to achieve this. The new typesetting will be more like a real book, with a space at the end of the line, or a hyphenated word split across two lines. This update is yet to roll out for E-Ink readers, but you can see it on the latest Kindle app.

For now, ePub readers such as the Kobo Glo HD have a far more refined and flexible appearance. With more fonts available, more font sizes, font-weight tweaking, the ability to use custom fonts from ePub eBooks and text-justification options, ePub



eReaders are well ahead of Amazon, which is only slowly beginning to catch up.

It's worth noting that a Wi-Fi 3G model is available. With the increased proliferation of Wi-Fi and smartphone-created hotspots we're not sure who really needs the 3G version, and at £180 it's an expensive convenience. Both models are available for £10 less if you're happy for Amazon to advertise to you on the lockscreen.

## KINDLE THE FLAMES

For most, the key question will be whether this new Kindle is worth the upgrade from their current model. The new Paperwhite is certainly a step up from the old one, but it's not enough to justify an upgrade. Those with older, unlit Kindles should seriously consider buying this new one, as it's far cheaper than the top-of-the-line Voyage, and the only real downside is the lack of a light sensor.

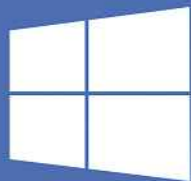
If you're buying an eReader for the first time, the new Paperwhite is the obvious choice. However, the Kobo Glo HD is smaller, smarter-looking, has better text-handling and an equally great screen. If you also want to keep your options open when it comes to booksellers, the Glo HD is arguably better.

Seth Barton

## SPECIFICATIONS

SCREEN SIZE 6in E-Ink mono touchscreen •  
 SCREEN RESOLUTION 1,448x1,072 • STORAGE 2GB •  
 SIZE 169x117x9.1mm • WEIGHT 205g (3G: 217g) •  
 WARRANTY One year RTB • DETAILS [www.amazon.co.uk](http://www.amazon.co.uk)  
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## CANON EOS 750D

COMPUTER  
SHOPPER

★★★★★

BEST BUY

£617 inc VAT (with 18-55mm kit lens) •

From [www.currys.co.uk](http://www.currys.co.uk)

## VERDICT

Responsive live view performance and consistent all-round quality makes the EOS 750D a safe bet

**SOME CAMERAS ARE** packed with attention-grabbing features, but we think the typical SLR owner would rather be dazzled by the quality of their shots than by the camera. That's the thinking behind Canon's latest consumer SLR, the EOS 750D. Its predecessor, the 700D (see *Reviews*, *Shopper* 309) didn't have anything to blow the competition away, but its consistently high quality made it our top choice for budding enthusiasts.

The 750D arrives two years later, and while there's not much to separate them externally, significant changes have been made inside. The new 24-megapixel sensor matches that of the camera's main rival, the Nikon D5500 (see *Reviews*, *Shopper* 329). A new metering sensor measures brightness at 7,560 points – a big step up from the 700D's 63-zone metering.

## DIAMOND WHITE

The autofocus sensor has been upgraded from nine to 19 points, all of which are cross-type for increased sensitivity. It's still short of the 39 points offered by the D5500 though, and its diamond-shaped array covers a smaller area in the centre of the frame.

For continuous shooting it matches the 700D and D5500 at 5fps, with a modest buffer that maintains this speed for seven Raw frames before slowing. Its battery life of 440 shots is far short of the D5500's 820.

The new metering and autofocus systems provide subject-tracking autofocus, something the 700D offered in live view mode but not when using the viewfinder. The 750D's subject tracking is more responsive and accurate in live view, although it seemed to wait for the subject to stop moving before focusing on it.

The 750D is still faster when using the

viewfinder. We measured 0.4 seconds, compared to around one second in live view mode. This live view performance is a big improvement over the 700D, though, which took more than four seconds between shots.

A new autofocus button cycles through the single-point, zone and auto modes and lets the user adjust the autofocus point. It's a surprising addition seeing as there's already a button on the back for this, although the new one is better in that it cycles around the three modes with repeated presses. You can move the autofocus using the touchscreen while looking through the viewfinder, which proved quicker than using the navigation buttons.

## RIGHT ON THE BUTTON

As before, there are dedicated buttons for drive mode, exposure compensation, white balance, ISO, autofocus mode, AE lock, Picture Style preset and depth-of-field preview, plus a Q Menu for other settings. The touchscreen makes this Q Menu a breeze to navigate.

We struggled to get Wi-Fi working with our Nexus 4 phone. NFC is supposed to simplify configuration, but instead it generated a new password every time it failed, making troubleshooting difficult.

The iOS app connected first time and gave us responsive full-screen photo previews. A remote viewfinder mode is included too, with the ability to move the autofocus point and adjust exposure controls.

The higher resolution gives a small but welcome boost to detail levels, putting the 750D on a par with the D5500. Noise levels are lower too, with an appreciable reduction in the shadows of photos at ISO 800 and above. There's little to separate the two for noise, but the 750D's JPEGs retained slightly more fine detail at ISO 3200 and above.

The video mode is

also well specified, encoding 1080p clips in AVC format at 24, 25 or 30fps with a choice of automatic or manual exposure. There's a socket for an external microphone but no headphone socket for monitoring.

We've often complained about a lack of detail in videos from Canon's consumer SLRs. The 750D is better than the 700D in this respect but still short of the standard set by Nikon SLRs. Moiré remains a problem, with swirls of interference over repeating patterns.

The 750D beats Nikon SLRs hands down for video autofocus, though. It's responsive, smooth and virtually silent when paired with an STM lens. The touchscreen made it easy to adjust the autofocus point while recording.

The 750D isn't the only new camera in the EOS range. The 760D arrived at the same time and is similar except for its dual dials and a passive LCD screen for settings. It can also shoot in live view mode with continuous autofocus. It's available body-only for £650.

We'd be more tempted by the EOS 70D, which ups the stakes with various additional buttons, 7fps shooting, a bigger battery and weather-sealed construction, for £735 body-only or £760 with the 18-55mm STM lens.

The fact that we'd struggle to choose between the 700D, 750D and 70D at current prices suggests that Canon has pitched this new family member well. We prefer it to the Nikon D5500, and the fact that it performs so well in live view mode means it can hold its own among CSCs too.

Ben Pitt



## SPECIFICATIONS

**SENSOR RESOLUTION** 24 megapixels • **SENSOR SIZE** 22.3x14.9mm (APS-C) • **FOCAL LENGTH MULTIPLIER** 1.6x  
 • **VIEWFINDER** Optical TTL • **LCD SCREEN** 3in (1,040,000 dots) • **OPTICAL ZOOM** (35mm-EQUIVALENT FOCAL LENGTHS) 3x (29-88mm) • **35mm-EQUIVALENT APERTURE** f/5.6-9 • **LENS MOUNT** Canon EF-S • **WEIGHT** 771g • **SIZE** 104x132x148mm • **WARRANTY** One year RTB  
 • **DETAILS** [www.canon.co.uk](http://www.canon.co.uk)





## ENTRY-LEVEL COMPACT SYSTEM CAMERA

# NIKON 1 J5



£349 inc VAT • From [www.currys.co.uk](http://www.currys.co.uk)

### VERDICT

More rounded than previous designs, but the Nikon J5 lacks a compelling reason to choose it over the competition

**NIKON'S J-SERIES** cameras have always had plenty to distinguish them in the crowded compact system camera (CSC) market, but not much to recommend them. The J5 is more conventional, with a contoured handgrip that makes it easier to hold. The screen tilts down by 90° and up by 180° for the obligatory selfie mode. This adds a millimetre or two to its thickness but is worth it for the convenience.

Nikon evidently wants to keep the size and weight down, with a smaller, 250-shot battery and a microSDXC slot, which is annoying for anyone who has a stack of full-size SD cards.

The J5 has more physical controls than the J4 (see *Reviews*, *Shopper* 322), including a command dial, a customisable Function button and a Wi-Fi button. A button marked F brings up key settings on the touchscreen, and the mode dial includes program, aperture-priority, shutter-priority and manual modes for the first time in a J-series camera. These were accessed through the menus in previous models, while the mode dial hosted various unorthodox shooting modes. There's nothing wrong with targeting casual users who aren't interested in conventional manual modes, but we believe a camera should be able to satisfy both types of user.

### SIDE SHOW

The J5 proves this point. Those unorthodox modes are still available, but they make more sense presented as interesting diversions. Best Moment Capture is relatively useful, taking 20 shots in a second including 10 from before the shutter button was fully pressed. It then selects the one it thinks is best, but you can select any or all of them.

The sensor can capture 20-megapixel photos at up to 60fps, but there's little benefit in having 20 almost identical shots. Outside the presets, continuous mode took around 50 seconds to save 20 frames in

JPEG format, and 90 seconds in Raw format. The 20fps, 10fps and 5fps modes are more useful because you can update focus between frames. This wasn't hugely reliable but there were enough sharp frames to make the mode worthwhile.

Considering its impressive continuous mode and autofocus performance, the J5 is disappointingly slow in normal use. It took 2.1 seconds between shots, although this fell to 0.5 seconds after we disabled Image Review.

Advanced Movie mode unlocks manual exposure control, slow-motion, fast-motion and time-lapse options and a 4K mode. The latter is limited to 15fps, which makes it little more than a novelty. There's no option to save 4K video frames as JPEGs, either, as various recent Panasonic cameras can.

The 1080p video mode is decent enough, with a choice of 30 or 60fps and a reasonably sharp picture. Autofocus was responsive but you can't control the autofocus point unless electronic stabilisation is disabled.

Nikon 1 cameras use a 1in sensor, the same size used with great success in Sony's RX100 III (see *Reviews*, *Shopper* 322) and Canon's G7 X (*Shopper* 327). It's smaller than most compact system cameras (CSCs) use, but this allows the camera and lens to be smaller too.

The J5 is actually 64g heavier than the Panasonic GM5 (*Shopper* 329), which uses a sensor with almost twice the surface area. The J5's sensor size and aperture are equivalent to a f/9.4-15 aperture on a full-frame camera, so it captures less light than the Panasonic GM5 (f/7-11.2) and much less than the Sony RX100 III (f/4.9-7.6).



Specs don't tell the whole story, though, as the J5 performed well in our image tests.

Noise levels were only marginally higher than from the GM5 and lower than from the RX100 III for a given ISO speed. However, the latter's wider apertures meant it could easily beat the J5 for a given shutter speed, producing significantly better results in low light.

### FIXED AND DILATED

Metering was generally well judged but the balance of shutter speed, ISO and aperture settings was odd at times. It used its widest aperture even in bright light, and while focus was generally sharp, the depth of field was sometimes narrower than we'd like. Low-light shots were mostly at a fixed 1/60s shutter speed, regardless of the zoom position or whether there was movement in the scene.

We've grumbled quite a bit in this review, but the J5 is a perfectly respectable camera. It's petite and comfortable to use, has a solid collection of features and its photo and video quality are unlikely to disappoint. There's no shortage of excellent cameras for around £400, though, and the J5 forces the user to choose between features that should be available simultaneously, such as image reviews and responsive performance. Shots in low light are unexceptional, battery life is poor and the use of microSD cards is annoying. Its competitive price keeps it in the running but we'd spend £395 on the Canon G7 X instead.

Ben Pitt



### SPECIFICATIONS

**SENSOR RESOLUTION** 20 megapixels • **SENSOR SIZE** 13.2x8.8mm • **FOCAL LENGTH MULTIPLIER** 2.7x • **VIEWFINDER** None • **LCD SCREEN** 3in (1,037,000 dots) • **OPTICAL ZOOM** (35mm-EQUIVALENT FOCAL LENGTHS) 27-81mm • **35mm-EQUIVALENT APERTURE** f/9.4-15 • **LENS MOUNT** Nikon 1 • **WEIGHT** 345g • **SIZE** 62x109x60mm • **WARRANTY** One year RTB • **DETAILS** [www.europe-nikon.com](http://www.europe-nikon.com)



## COMPACT SYSTEM CAMERA

# CANON EOS M3



£514 inc VAT • From [www.johnlewis.com](http://www.johnlewis.com)

### VERDICT

Not perfect, but superb controls and outstanding image quality make the Canon EOS M3 a serious contender

**CANON'S FIRST COMPACT** system camera was essentially the guts of an EOS 650D stuffed into a compact body. The EOS M (see *Reviews*, *Shopper* 304) wasn't a bad idea, but its autofocus was dire and the controls basic. The EOS M3 doesn't make the same mistakes.

It's styled as a compact camera but feels robust in its magnesium alloy body. The 3in touchscreen tilts up and down, which may be slightly less versatile than a flip-out screen, but we find it quicker and easier to use.

Best of all, it has four dials: a command dial around the shutter button, a wheel on the back, an exposure compensation dial and a mode dial. These give tactile control over exposure settings, with the camera handling overall exposure with ISO adjustments.

It has plenty of buttons, too, including two customisable buttons, and the touchscreen-controlled Q Menu provides quick access to other key features. However, while white balance presets can be accessed using the Q Menu or a customisable button, manual white balance, which is buried in the fourth tab of the main menu, should be easier to access.

Autofocus options are more elegant. The auto mode incorporates face detection, and tapping the screen invokes subject tracking. Flexible spot lets the user place the autofocus point freely in the frame. Manual focus is well implemented too, with an MF button on the back and the ability to magnify the preview by 5x or 10x via another dedicated button.

Autofocus is faster than on the EOS M but still not great. It took between half and one second to capture a shot, which is roughly double what most CSCs manage. Shots taken in quick succession were 1.1 seconds apart, but pressing the shutter button too quickly made the camera shoot without focusing first. When we gave it time to refocus, the fastest it

could manage was 2.2 seconds between shots.

Continuous mode was better at 4.3fps, continuing indefinitely for JPEGs and slowing to 1.4fps after four Raw frames. Enabling Servo AF for updating autofocus between shots slowed performance to 1.7fps, but that's still better than waiting for 2.2 seconds (equivalent to 0.45fps).

The EOS M3 is smaller and lighter than any SLR but not by much. At 580g with its kit lens, it's nearer to the 750D (771g) than the Panasonic GF7 (341g). While most CSC makers have shrunk their 3x zoom kit lenses, Canon uses a relatively bulky 18-55mm lens.

delivering lifelike skin tones. Automatic exposures were well judged, with face detection successfully coping with strong backlights. Shutter and ISO speeds were sensibly managed to balance the risks of noise and motion blur in low light. The kit lens delivered too, with sharp focus across the frame and throughout the zoom range.

The EOS M3 is an excellent video camera. Clips up to 30 minutes long are captured at 1080p at 24, 25 or 30fps. Quality is generally excellent, although fine details lacked the precision shown by Panasonic and Sony CSCs. The M3 nailed video autofocus, though, with responsive, touchscreen-controlled subject

## At £514, the EOS M3 is keenly priced considering its upmarket controls and superb image quality

Switching to the 22mm f/2 pancake lens reduces its size and weight, but other CSCs have pancake lenses of their own too.

A 55-200mm lens and an 11-22mm lens complete the meagre range. An adaptor is available for attaching Canon SLR lenses, but this makes the camera front-heavy.

The EOS M3 uses the same battery as the 750D, but because it runs permanently in live view mode it lasts for only 250 shots. That may not be enough for a day's use, especially if you use Wi-Fi. The accompanying Android and iOS apps provide elegant image browsing, the ability to star-rate your pics and transfer of JPEGs, as well as a remote viewfinder mode with control over autofocus and exposure settings.

The EOS M3 appears to use the same sensor and JPEG-processing engine as the EOS 750D, and quality was just as high, narrowly outperforming the Sony A6000 (see *Reviews*, *Shopper* 319) but unable to match the low noise of the Fujifilm X-E2.

We've always had a soft spot for the colour processing in EOS cameras, with a tendency towards rich, saturated tones while still

tracking. It handled manual exposure well, and you can adjust settings using the touchscreen while recording to avoid spoiling the soundtrack. There's also an onscreen button to switch to manual focus while recording. The built-in mic sounded a little boxy, with a lack of very high and low frequencies, but there's a 3.5mm socket for an external mic.

At £514, the EOS M3 is keenly priced considering its upmarket controls and superb image quality. The small range of compatible lenses is a concern, as is the pedestrian performance and short battery life, but you'd have to spend £200 more on the Fujifilm X-E2 to get something substantially better.

Ben Pitt



### SPECIFICATIONS

**SENSOR RESOLUTION** 24 megapixels • **SENSOR SIZE** 22.3x14.9mm (APS-C) • **FOCAL LENGTH MULTIPLIER** 1.6x  
• **VIEWFINDER** Optional EVF-DC1 • **LCD SCREEN** 3in (1,040,000 dots) • **OPTICAL ZOOM** (35mm-EQUIVALENT FOCAL LENGTHS) 3x (29-88mm) • **35mm-EQUIVALENT APERTURE** f/5.6-9 • **LENS MOUNT** Canon EF-M • **WEIGHT** 580g • **SIZE** 70x117x109mm • **WARRANTY** One year RTB • **DETAILS** [www.canon.co.uk](http://www.canon.co.uk)





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## HIGH-END GAMING MONITOR

# ACER

## Predator XB270HU

**COMPUTER SHOPPER** ★★★★★  
**RECOMMENDED** £701 inc VAT •

From [www.scan.co.uk](http://www.scan.co.uk)

### VERDICT

The Acer Predator gaming monitor is at the top of the food chain

**GAMING MONITORS HAVE** seen a surge in popularity this year, and gamers now have a huge amount of choice over screen size, refresh rate, resolution and image quality. The Acer Predator XB270HU represents one of the most impressive technical achievements to date, with a 2,560x1,440-pixel IPS-like AHVA panel that can refresh at 144Hz.

AHVA is AU Optonics' name for a display technology that's functionally identical to LG's IPS. Technical jargon aside, you only have to switch on the monitor to see why it costs so much: its image quality is the best we've seen from a gaming monitor. Colours are vibrant and punchy, with stunning performance confirmed by the 97.7% sRGB colour gamut coverage we measured with our colour calibrator. Contrast is high, too, at 1,123:1, and low black levels of 0.3cd/m<sup>2</sup> contribute to rich detail in images, videos and games.

The monitor is incredibly bright at its default settings, producing a wince-inducing brightness of 342cd/m<sup>2</sup>. Our eyes were begging for mercy within minutes, so you should definitely turn this down. The backlight was generally uniform across the panel, with the darkest part of the screen 14% darker

The Predator is the most technically impressive monitor we've ever seen. A 144Hz refresh rate IPS-like panel was a dream a couple of years ago; now it's an expensive reality

than the point at which it's at its brightest. This disparity isn't particularly noticeable even at full brightness, and as we don't imagine that many people will be able to stomach the squint-inducing 100% brightness setting, you're unlikely to notice it at all. Viewing angles are reasonably wide, meanwhile – we started noticing a faint blue tint only as we moved the monitor to more oblique angles.

The high resolution is a big help, producing pin-sharp images and crisp text. You'll need a powerful graphics card to play the latest games at 2,560x1,440 resolution, but if you're spending £700 on a monitor, you probably already have a beefy gaming setup.

Fast onscreen movements look silky-smooth with the refresh rate at 144Hz, and

performing very quick backlight adjustments. Sadly, you can only benefit from ULMB when the monitor is set either to 85Hz or 100Hz, and you also need to have G-Sync turned off. Unless you're very sensitive to motion blur artefacts, you'll probably get more benefit from G-Sync than from ULMB.

The plain design, which is free from bright colours and distractions, is apparently preferable for professional gamers, although Acer has opted for glossy plastic rather than matt. This looks a little cheap and isn't in keeping with what is a very expensive monitor. What's more, because the panel is set so far back into the frame, the glossy bezel reflects the contents of the screen, which is surprisingly distracting.



even desktop tasks feel snappier thanks to the quicker refresh time. Even better, Nvidia's G-Sync (which we discussed in detail in *In Depth, Shopper 326*) completely eliminates frame tearing by keeping monitor refresh rates synchronised when paired with a compatible graphics card. On a monitor with such a fast refresh rate, frame tearing is admittedly less of an issue than it would be on a monitor that refreshes at just 60Hz, but considering the price, it's a nice feature to have. Bear in mind that G-Sync only works with Nvidia graphics cards. AMD owners will need a monitor that supports FreeSync to get the same effect.

Also present in the monitor's relatively sparse onscreen menus is an option for Ultra Low Motion Blur, which keeps blurriness on fast-moving objects to a minimum by

There's a red rim where the monitor stand meets the base, but that's about it for design flair. The stand is immensely versatile in the degree of swivel and tilt it provides, though, and can even rotate the screen 90° into portrait mode. The screen elevation on

offer ranges from around 5cm to 20cm.

Connectivity is limited to a single DisplayPort, which is a result of using the Nvidia G-Sync module. If you'll only be connecting the Predator to your desktop computer, however, you'll be fine.

The monitor also has four USB3 ports: two on the left side of the monitor for easy access, and two more on the back facing down. This is handy for anyone who doesn't want lots of wires trailing across their desk and helps if you want to use the monitor as a docking station for your laptop – assuming it has a DisplayPort connector or you have an HDMI adaptor.

The Acer Predator XB270HU is the most technically impressive monitor we've ever seen. A 144Hz refresh rate IPS-like panel was a dream even a couple of years ago, but now it's an expensive reality. Our only real problem with this monitor is its lack of inputs. In this day and age a single DisplayPort is a serious compromise, and while we understand that this is a technical limitation imposed by its use of the Nvidia G-Sync module, we certainly don't agree with it. If you can look past this, though, this is an excellent gaming monitor.

Michael Passingham

### SPECIFICATIONS

SCREEN SIZE 27in • RESOLUTION 2,560x1,080 • SCREEN TECHNOLOGY AHVA • REFRESH RATE 144Hz • VIDEO INPUTS DisplayPort • WARRANTY Two years RTB • DETAILS [www.acer.co.uk](http://www.acer.co.uk) • PART CODE UM.HB0EE.009

### CONNECTION PORTS

DisplayPort





# AOC

A large AOC Q2577PWQ monitor is shown, displaying a vibrant image of a snowboarder in mid-air over a snowy mountain slope. The monitor has a sleek, modern design with a wide bezel and a stand. The background of the entire advertisement is a blurred, high-action shot of the same snowboarder, creating a sense of motion and immersion.

**Q2577PWQ**

## Cutting-edge features, stylish good looks

The new Quad HD panel ensures that users can enjoy a full view of a website at a single glance without image distortion. IPS technology is one of the highest performing panel technologies currently available for displays. This way, AOC makes sure users will greatly benefit from high accuracy in colour, contrast and wide viewing angles. In order to give users a variety of options for connecting different input sources, the AOC Q2577PWQ comes with DisplayPort, HDMI, DVI and VGA. Also comes with a feature that ensures a zero-flickering viewing experience.

**New 32-inch size available from July 2015**

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## COMPACT HOME CINEMA PROJECTOR

# BENQ W1350



£790 inc VAT • From [projectorpoint.co.uk](http://projectorpoint.co.uk)

### VERDICT

A compact projector with great image quality, but a bit of judder just spoils things a little

**COMPACT PROJECTORS ARE** great for temporary home cinema setups, where a lack of space or money means you can't install a permanent screen or mount a projector on the ceiling. The Full HD BenQ W1350, with its tiny 330x120x247mm chassis and 3.7kg weight, is ideally suited to such a role.

The W1350 has practicality to match its portability. The throw ratio of 1.39-2.09 means you get a sizable 65in image from just two metres, and with 30° of horizontal and vertical keystone adjustment, a generous amount of vertical lens shift, plus zoom and focus knobs, you can place the projector at any reasonable angle and get a straight picture. There are two adjustable feet at the rear and a retractable foot at the front, too, so you'll be able to fine-tune it when it's placed on a table.

Some models are supplied with a wireless projection kit and cost around £200-£250 more. We weren't supplied with this hardware, however, so can't comment on its reliability.

### IMAGE CONSCIOUS

Image quality is impressive. The default colour mode is so good, in fact, there's little reason to delve into the picture adjustment menus. If that's your bag, you'll find individual hue, gain and saturation settings for red, blue, green, cyan, magenta and yellow, as well as contrast, brightness and gamma settings. The only adjustment we felt compelled to make was a slight bump in contrast; even in a dark room we felt dark greys in dark movie scenes were just a little crushed.

The menu system is a little cluttered and it can be hard to find the setting you want, but the backlit remote control is responsive and has plenty of shortcut buttons for ease of access for commonly used settings.

The projector uses a single-chip DLP projection system with a bright 2,500 ANSI lumens lamp. The spinning colour wheel inside the projector has six segments (two lots of RGB) for

better colour coverage, and we have to say this has been a success. Colours in bright photos are vibrant, while skin tones in movies are natural. The Full HD resolution means there's a huge amount of detail visible in Blu-ray movies and games. Some single-chip DLP projectors suffer from a rainbow effect when watching fast-moving images or when your eyes pan across the screen, but we didn't notice this in our testing.

What we did notice was a fair amount of judder on objects moving across the screen. Projectors starting from around £1,000 have built-in frame interpolation technology, but the W1350 has no such option. Judder was very noticeable in the opening scene of *Star Trek: Into Darkness*, and this continued through the rest of the movie.

### VALUABLE INPUT

There's a wide range of inputs on the back of the projector, including VGA, two HDMI connectors (one of which can connect to MHL-enabled smartphones and tablets), a set of component connectors and a composite video port, too. There's also a pair of 3.5mm audio input and output jacks, and a pair of left and right composite audio connectors.

Also supplied is a pair of active shutter 3D glasses. When you activate 3D and don the glasses, a lot of image vibrancy is lost, but if you're a 3D fan, the effect is pretty convincing. There's a little bit of crosstalk on objects in the immediate foreground, such as the undergrowth in *Avatar*, but it's barely noticeable and didn't detract from the experience too much. It's a shame two pairs aren't supplied, although when you consider a single pair retails for more than £80, it's understandable.

Playing games in both 2D and 3D is great, and we measured input lag at between 27ms and 33ms, which is fine for non-competitive gaming. The juddering issues we have with movies

is still present, but less noticeable in faster-paced games and didn't harm our enjoyment.

Projectors often miss the mark with their built-in speakers, and while it's excusable on kit that's designed to be mounted and permanently plugged into a home cinema system, portable projectors need as few cables as possible to avoid tangles and trips. The 10W speaker built into the W1350 is very good indeed, providing crisp and clear speech, music and sound effects. You'll never manage to recreate the bass presence of a home 5.1 home cinema system with this projector, but it does a fine job by itself.

### THE MIGHTY WHOOSH

While the projector gets hot to the touch, the internal fan never becomes unbearably loud. Noise is rated at 34dB, and while there's a definite constant whooshing sound, turning the volume up easily overcomes this.

The BenQ W1350 is a decent compact projector with great speakers and excellent active shutter 3D. However, it sits in a slightly awkward middle ground where £200 more will get you the Optoma HD50, which has frame interpolation technology for less judder. Meanwhile, £100 less gets you the Optoma GT1080, which also uses a single-chip DLP system and benefits from a slightly brighter lamp, although its colours aren't as strong and it doesn't have the useful lens shift or horizontal keystone of the W1350. If you need something versatile and have the budget, the BenQ W1350 is still a good choice.

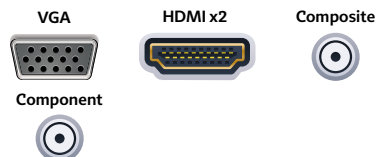
*Michael Passingham*



### SPECIFICATIONS

**PROJECTOR TYPE** 1-chip DLP • **NATIVE RESOLUTION** 1,920x1,080 • **VIDEO INPUTS** VGA, 2x HDMI, Composite, Component • **LAMP LIFE** 2,000h • **LAMP BRIGHTNESS** 2,500 lumen • **SIZE** 120x330x247mm • **WEIGHT** 3.7kg • **WARRANTY** Two years RTB • **DETAILS** [benq.co.uk](http://benq.co.uk) • **PART CODE** W1350

### CONNECTION PORTS







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## ULTRA HD OLED TV

# LG 65EC970V



£5,499 inc VAT • From [www.selfridges.com](http://www.selfridges.com)

### VERDICT

Technically impressive with superb image quality, but image adjustment is fiddly

**THE LG 65EC970V** is packed with technology that makes it one of the most technically impressive TVs we've seen, both on paper and in the flesh. The 3,840x2,160 Ultra HD, curved panel with OLED technology ticks a few boxes immediately, making it supremely desirable.

That desirability is helped by a stunning design. The wide curve, rounded stand and tiny bezels create a style no other TV can match. This 65in model is the only entry in the EC970V range, with a footprint that will challenge even the biggest of living rooms.

It's a shame you don't get the latest version of LG's excellent WebOS Smart TV interface; the 65EC970V is stuck on last year's software. It runs, for the most part, smoothly, with brightly coloured, easy to navigate menus making it a genuine pleasure to use. We found ourselves using the 'magic remote' more often than not, which uses motion sensors to work out where you're pointing it.

There's a reasonable array of on-demand services available including Wuaki.tv, Amazon Instant Video and Netflix, the latter of which can display content in 4K if you have a Netflix 4K subscription. The only catch-up services on offer are BBC iPlayer and Demand 5.

### SOURCE BOTTLE

Unlike conventional LED TVs, each individual OLED comprising the 65EC970V's panel is its own light source, meaning it can switch off independently to produce absolute black when required. Because the OLEDs themselves are the light source, there's no noticeable shift in contrast or colour when watching from an oblique angle, so you should get the same picture wherever you sit in a room.

Out of the box the TV defaults to Eco mode, but on switching to Standard we were happy with an sRGB colour gamut coverage of 99.3% and absolute blacks in dark scenes, with no light emitted from OLEDs tasked with displaying black. This is particularly stark in *Star Trek*, with the inky black of space punctuated by pinpricks of bright



stars, and the shadowy fields of Iowā revealing more detail than we've seen before thanks to the subtle shading nuances that OLED technology allows.

Such a massive shift in image quality brings with it a whole new level of image enhancement options that will keep you occupied for some time. The 65EC970V lets you adjust OLED brightness, overall brightness, sharpness, saturation, tint, gamma and colour temperature, with additional options for dynamic contrast, grass, skin colour and sky colour. If you enable ISF Expert mode, these options become settings that can be tweaked even more minutely. This option also enables individual colour tweaks for red, green blue, cyan, magenta and yellow, allowing you to adjust saturation, tint and luminance.

We found the Standard picture mode a good starting point for creating a slightly more attractive image for broadcast TV, and we turned on Super resolution upscaling to bump up the sharpness of blurrier spots without creating distracting noise elsewhere.

We were never quite able to produce skin tones we felt looked natural without washing out the rest of the image, which was a little distracting, and those who are passionate about image quality should consider bringing in a professional to get things looking as good as possible.

The noise-reduction options are welcome for upscaled SD content from terrestrial broadcasts, making images look slightly sharper with only a little of the blotchiness these filters tend to create. They are substantially less useful on HD broadcast content, and to be avoided at all costs on Blu-ray and 4K content; in broadcast HD content such as



BBC News, close-ups on faces looked very blotchy and had a distracting, almost greasy look to them.

LG's TruMotion judder reduction uses blending techniques to remove juddery motion on scenes with objects moving slowly across the screen. As much as we tried, however, we couldn't find a setting that was entirely satisfactory, with shaky moments still very much present in certain scenes.

### LAG OF CONVENIENCE

This is not a TV you're going to want to play twitchy games on, however. While OLEDs themselves have quick response times, the amount of image

processing leads to 104ms of input lag according to our Leo Bodnar tester. Switching to Game mode with all enhancements turned off saw lag drop to 78ms, but this is still high for an optimal gaming experience.

The 40W speakers create an impressive sound. Music, explosions and speech are all equally well served, with reasonably deep bass and crisp mid-tones. Even at the highest volume, there's no hint of distortion.

The LG 65EC970V is a technical marvel that requires a lot of fiddling to achieve picture perfection, but even without adjustment, watching any movie with dark scenes and shadows is an utter joy. It's hard to imagine going back to a traditional LED TV after seeing what an OLED is capable of. You pay for this, of course, but if you're looking for the most impressive 4K TV on the market right now, you'd better get your credit card out.

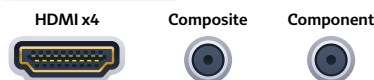
*Michael Passingham*



### SPECIFICATIONS

**SCREEN SIZE** 65in (curved) • **NATIVE RESOLUTION** 3,840x2,160 • **VIDEO INPUTS** 4x HDMI, Composite, Component • **TUNER** Freeview HD • **DIMENSIONS** 1,447x880x257mm • **WARRANTY** One year RTB • **DETAILS** [www.lg.com/uk](http://www.lg.com/uk) • **PART CODE** 65EC970V

### CONNECTION PORTS





## OMNIDIRECTIONAL BLUETOOTH SPEAKER

# CRYSTAL ACOUSTICS

## Cuby 7 WiSound



£249 inc VAT • From [www.crystallaudio.com](http://www.crystallaudio.com)

### VERDICT

The Cuby 7's WiSound projects audio in every direction on a horizontal plane, but it has problems vertically

**SPEAKERS PROJECT SOUND** in one direction, meaning there's always going to be a distinct 'sweet spot' directly in front of the drivers. You can imagine this being a cone coming out of the speaker – deviate away from this and you'll find sound quality, tonality and volume begin to drop off.

Crystal Acoustics aims to avoid this problem with WiSound, a technology that uses drivers and tweeters firing in different directions to disperse sound around a room more widely. Sound is then also able to reflect off walls and ceilings to further dissipate the sound. This is something we've seen before from the company's Teevy 6 soundbar, but it makes more sense in the Cuby 7 wireless speaker.

Rather than use a front-dominant driver arrangement, the Cuby 7 predominantly fires upwards, with side drivers providing support. The seven drivers inside comprise two ¾in upward-firing tweeters, four 2in mid-range drivers on the sides and top of the cabinet, and a 6½in subwoofer.

## The volume and sound-quality disparity we were used to on a horizontal plane was evident on the vertical plane

The Cuby 7 does a good job in removing the narrow soundstage prevalent in many speakers. There was no noticeable drop-off in sound quality or presence as we walked around the speaker, with our tracks more clearly following us as we paced around the room. However, the volume and sound-quality disparity we were used to on a horizontal plane was now evident on the vertical plane. Sitting down and standing up presented a shifting sound.

While WiSound isn't perfect, the shift was at least reasonable and it does successfully increase the soundstage. The Cuby 7 sounds best when it's placed around waist level or below so that your ears have greater appreciation of the upward-firing drivers and there's less opportunity for you to be below the level of the upward-firing drivers.

In terms of audio quality, we found the Cuby 7 presented quite a warm sound. It has a respectable 35Hz to 27,000Hz frequency



range, but the bass began to dominate some of our electronic test tracks and distorted slightly at louder volumes. There was also a considerable amount of cabinet reverberation as we reached close to maximum volume, which proved a little distracting on certain tracks.

Mids and trebles tend to feel slightly lost and weren't handled with the delicateness we would have liked. The Cuby 7 is by no means a bad-sounding speaker, especially if you like your music with a strong bass presence, but it doesn't stand up to critical listening for those favouring a neutral sound signature. There's no lack of volume, however. The Cuby 7 won't struggle to fill a large room, especially with sound bouncing off walls and ceilings.

The cube-shaped speaker has a slightly divisive design, bordering between stylish and something resembling a bread bin. It's reasonably large too, at 235mm cubed, so you'll need a decent-sized surface.

The row of controls for volume and playback on the top of the speaker look and feel a little cheap. A small remote control is also included but it's rather flimsy; a stark contrast from the well-finished speaker cabinet, which is also reassuringly weighty.

You're able to connect your music devices over Bluetooth, and there's support for the less-lossy aptX codec as well if your audio player supports it. A 3.5mm audio input, pair of RCA jacks and an optical in socket let you hook up wired devices too, while the powered USB port provides a convenient way to charge your devices. Unfortunately, however, there's no multiroom support, which is a shame considering the Cuby's size.

WiSound does a good, albeit not perfect, job of filling a room more evenly with sound. However, we weren't fond of the Cuby 7's sound quality. It's a very capable speaker, but for one of this physical size and price we would have liked to have seen a little more versatility with, for example, multiroom support.

As it stands, we would rather spend slightly less on a more traditional Bluetooth speaker such as the Audio Pro Addon T10, which sounds fantastic and has a less divisive design.

Richard Easton

### SPECIFICATIONS

**SPEAKERS** 7 • **RMS POWER OUTPUT** 100W • **DOCK CONNECTOR** None • **WIRELESS** Bluetooth (SBC, aptX) • **DIMENSIONS** 235x235x235mm • **WEIGHT** 6kg • **WARRANTY** One year RTB • **DETAILS** [www.crystallaudio.com](http://www.crystallaudio.com) • **PART CODE** BTK-7-BUK

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## HOME CINEMA SYSTEM

# LG LHB725

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RECOMMENDED



£399 inc VAT • From [www.johnlewis.com](http://www.johnlewis.com)

### VERDICT

A great all-round home cinema system with smart functionality and great picture and sound quality

**LG'S EMINENTLY POWERFUL** LHB725 5.1 home cinema system has a combined speaker output of 1,200W, but that doesn't come at the expense of a sleek design. Each of the five speakers use aramid fibre speaker grilles that are designed to minimise distortion. The fact that they come in a shade of gold that contrasts nicely with the glossy black cabinets is an added bonus.

None of the components is particularly large, and the Blu-ray player in particular is compact. The largest part of the system is the subwoofer, which at 191x388x318mm will prove trickiest to place. Thankfully it comes with a decent length of speaker wire, so you could feasibly hide it behind a sofa.

Similarly, the five speakers use conventional speaker wire and there's plenty of cable provided for the rear satellites. Colour-coded wiring makes installation a breeze, as do the spring terminals on the back of the main unit. It's here you'll find the Ethernet port for getting the Blu-ray player connected to a network, or you could use the integrated Wi-Fi for a wireless setup instead. The initial setup wizard is straightforward and quickly walks you through the connection process.

### PLAYING CATCH-UP

Once online, the LHB725 can access on-demand and catch-up services from the likes of Netflix, Amazon Instant Video and YouTube and music streaming from Spotify, although the catalogue isn't as expansive as LG's Smart TV range. We had to install an update before any of these would work, however, and with no progress bar it wasn't obvious anything was happening. Navigating through services was also a little slow, so you'll need to be patient while apps open.

You can use Bluetooth to wirelessly send audio directly to the system, or



add it to an LG Music Flow multiroom audio setup if you have compatible speakers. This is great for parties, but Private Sound mode is more useful for when it's time to keep the noise down. Using the iOS or Android companion app, you can use your smartphone and a pair of headphones to listen to the system, similar to how connecting a set of headphones to a Roku player's remote control redirects the television audio. It's very useful for when you don't want to wake the rest of the house while watching late-night movies.

The LHB725 supports HDMI ARC, so you won't need a second cable to output sound from your TV's integrated tuner through the 5.1 speakers, although a digital optical input is available for older sets. Two HDMI inputs let you hook up games consoles or set-top boxes, while the front USB port supports flash drives and external

contrast. We were also pleased to see Blu-ray discs start up in under 15 seconds.

Sound quality is equally excellent, with plenty of detail and separation. There was a genuine sense of directionality to the sound while watching an action-packed movie such as *Avatar*, with the feeling of arrows zipping past us. The delivery of the lower frequencies from the subwoofer is well controlled and adds some nice weight to more intense action scenes. A comprehensive equaliser lets you make more minor adjustments to the treble and bass of each speaker.

### SYNCING FEELING

We were slightly annoyed by how difficult it was to get audio properly synced to our reference TV; you have to exit out of a Blu-ray to access the settings menu to adjust the delay, then start the Blu-ray from the very beginning to see if you've adjusted enough. It

There was a genuine sense of directionality to the sound while watching the action-packed *Avatar*, with the feeling of arrows zipping past us



hard disks. The LHB725 can handle an array of image, music and video formats, including JPG, MP3 and MKV.

3D Blu-ray playback looks fantastic, with lots of crisp detail and accurate colours that matched our reference Blu-ray player. The LHB725 was, however, lacking in contrast out of the box. Fortunately, you can opt for different picture modes, or tweak the image to your liking with a user-defined mode. We would definitely advise turning up the

requires a lot of trial and error, but fortunately it's a process you're likely to do only once. It's also worth adjusting the distance between your viewing position and each individual speaker, which ensures you get the best spatial sound representation from surround-sound films and games.

The LG LHB725 is competitively priced for a 3D-capable Blu-ray cinema system, especially considering its raft of extra features such as multiroom audio. The Teufel Concept E (see *Shopper* 315) costs £50 less, but the Smart TV functionality and multitude of inputs make the LHB725 worth the extra.

*Richard Easton*



### SPECIFICATIONS

HDMI INPUTS/OUTPUTS 2/1 • HDMI 2 INPUTS/OUTPUTS 2/1 • OUTPUT RESOLUTIONS 720p, 1080p • WIRELESS SUPPORT 802.11n, Bluetooth • SPEAKER CONFIGURATION 5.1 • RMS POWER OUTPUT TOTAL 1,200W • DIMENSIONS 410x55x260mm • WARRANTY One year RTB • DETAILS [www.lg.com/uk](http://www.lg.com/uk) • PART CODE LHB725





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## WATERPROOF ACTION CAMERA

# GOPRO Hero4 Session

COMPUTER  
SHOPPER  
RECOMMENDED



£330 inc VAT • From [www.jessops.com](http://www.jessops.com)

### VERDICT

The smallest, lightest GoPro to date is waterproof without a case but there are a few minor niggles

**GOPRO'S ACTION CAMERAS** have always been great for capturing high-octane activities and were never averse to getting a good soaking as long as you used a watertight case. That's all changed with the Hero4 Session, which is waterproof to 10m all by itself.

The Session is an adorable little cube that's 50% smaller and 40% lighter than the rectangular Hero4 Black. This new shape makes the Session much more aerodynamic than its forbears, whether you mount it face-on or sideways. We barely noticed it even when head-mounted. The new low-profile frame should also help with streamlining, while the ball-joint

pairing mode with the smartphone app or optional remote control. There's no way to change settings without the app, and you can't even activate single-shot mode from the camera itself. If don't have the app and you want to take a photo, you'll have to capture shots in a burst and choose your favourite.

The Session captures 1080p video at up to 60fps, or 2,560x1,400 clips at 30fps. There's also a 100fps, 1,280x720 slow-motion mode. The maximum 25Mbit/s bit rate is lower than that of the Hero4 Black or Silver, but we were still impressed by the Session's picture quality. Our footage looked sharp and vibrant, with colours that really popped out of the screen.

With twin microphones – one at the front and one at the back – the Session switches dynamically between the two, cutting out distracting sounds such as wind noise

mount makes it easy to adjust the angle and direction of the camera on the fly.

One-touch controls return from previous GoPro models, allowing you wake up the camera and start recording instantly by pressing the shutter button. A second press stops capturing and turns the camera off. A long-press of the shutter button takes 8-megapixel timelapse shots at a set interval, which you can change, along with the recording resolution, using the GoPro companion apps for iOS and Android.

Turning on the camera and starting to record takes about three seconds, which could potentially mean you miss the moment unless you plan ahead. We also struggled to hear the confirmation beep in loud environments. The haptic feedback that rival cameras such as the Ion Air Pro 3 provide would have made a nice inclusion here.

The only other button is the multifunction power button, which means the Hero4 Session has two buttons rather than the three you'll find on any other GoPro model. A rudimentary LCD menu system shows the video resolution and provides a way to put the camera into

It can't quite match the video quality of the Silver or Black models, but we came away from a white-water rafting session pleased with our captures. Performance in low-light was less satisfactory, with soft, noisy video. However, despite a lack of image stabilisation – which the Session shares with the rest of the GoPro range – footage was very steady.

Sound is often as important as the visuals when action footage is concerned. GoPro has made a great job of the Session's audio



capture quality, thanks largely to the lack of a waterproof housing, which muffled sound on previous models. With twin microphones – one at the front and one at the back – the Session switches dynamically between the two, cutting out distracting sounds such as wind noise. During our white-water rafting session, it was able to pick up the sound of our instructor who was sitting at the back of the raft, even over the sound of the river.

Another drastic change is that the battery is now integrated. This means you can't swap batteries in the field, which could be a problem for anyone who spends the entire day off-piste. We managed to shoot 1h 28m of 1080p/30fps video, which is roughly on a par with the Hero4 Black's performance. The switch to Micro USB for charging is welcome, however, as it potentially means carrying one less charging cable, as well as compatibility with portable battery packs.

Minor niggles aside, the Session is a great action camera – if a little expensive. Serious athletes and videographers would be better off with the Hero4 Silver or Black, as they provide more professional features, higher specifications and replaceable batteries. For less demanding users, though, the Session is a great and simple device for capturing footage. The new design is fantastic and fun, and with no need for a waterproof case, the Session is considerably smaller than other Hero4 cameras for water-based activities.

*Richard Easton*



### SPECIFICATIONS

SENSOR  $\frac{1}{2.3}$  CMOS • SENSOR PIXELS 8,000,000 •  
MAXIMUM RECORDING RESOLUTION 1440p (30fps) •  
AV CONNECTIONS None • SIZE 35x35x35mm • WEIGHT  
74g • WARRANTY One year RTB • DETAILS [www.gopro.com](http://www.gopro.com) • PART CODE CHDHS-101-EU



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## A4 SCANNER

# CANON CanoScan LiDE 220

COMPUTER  
SHOPPER  
RECOMMENDED



£59 inc VAT • From [www.lambda-tek.com](http://www.lambda-tek.com)

### VERDICT

A good standalone A4 scanner, but you could get a decent MFP for similar money

**THE CANOSCAN LiDE 220** is a slim desktop scanner made from smart black plastic. There's no backlight for scanning film, but it can capture documents at up to an extremely detailed 4,800dpi – enough to turn a postage stamp into a 4K still. It can also output scans with a 48-bit colour, 16-bit greyscale depth if you enable this in the settings, although not all imaging applications support the results.

Like many modern scanners, the LiDE 220 gets its power from its USB connection. The stand allows you to balance the scanner on its

side, but we're not really sure why – it's hard to stop documents sliding off the platen glass before you can trap them with the lid. Using the LiDE 220 conventionally makes much more sense. Five action buttons at the front let you trigger a photocopy, create an email with a scanned attachment, produce a single or multi-page PDF file, or just create an image. A clever 'Z' arrangement in the hinge allows the lid to close flat even on quite thick originals, but we weren't impressed with the saggy white card plate that lines the underside and is fixed only at its corners.

The LiDE 220 misses out on Canon's excellent CaptureOnTouch software, which is supplied with its more expensive document scanners, but it still comes with a decent package. Canon's TWAIN interface is one of the best and imports scans into almost any imaging software. Its basic and advanced modes are easy to use and, between them, cover everything you could need. Other software lets you adjust detailed settings for



the front-panel buttons or for scans controlled from the PC. We were pleased to see that, by default, PDF scans use optical character recognition (OCR) to create a searchable document.

It isn't slow, but the LiDE 220 exhibited the same relaxed pace as other USB-powered scanners. It previewed the platen in 15 seconds, took the same time to capture an A4 document at 150dpi, and needed 18 seconds to scan it at 300dpi. At 600dpi it captured a 6x4in photo in just 21 seconds, but at 1,200dpi it took 68 seconds. Image quality was faultless: scans were sharp, with accurate colours and plenty of detail in both the lightest and darkest shades.

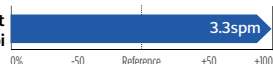
We'd recommend the LiDE 220, but only if you really need its high resolution and extra bit depth. If not, a cheaper scanner would suffice, or for the same money you could buy a mid-range multifunction peripheral and get prints and copies thrown in.

*Simon Handby*

### SPECIFICATIONS

SCANNER TYPE Flatbed • MAX OPTICAL SCAN RESOLUTION 4,800x4,800dpi • DIMENSIONS 41x252x366mm • WEIGHT 1.6kg • WARRANTY One year RTB • DETAILS [www.canon.co.uk](http://www.canon.co.uk) • PART CODE 9623B010AA

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See page 72 for performance details

## A4 MONO PRINTER

# RICOH SP 3600DN

COMPUTER  
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£169 inc VAT • From [www.nigelohara.com](http://www.nigelohara.com)

### VERDICT

Fast and robust, with good print quality and low costs, Ricoh's SP 3600DN is a winner

**THE SP 3600DN** is a fast mono printer for a small office or workgroup. It's designed for fairly hard use, with a maximum duty cycle of 50,000 pages per month and a claimed speed of 30ppm. There's no Wi-Fi and no front-panel USB port for walk-up printing, but it has a wired Ethernet port. Duplex (double-sided) printing is standard, and the maximum print

resolution is 1,200dpi – more detailed than the 600dpi you get on entry-level printers.

The SP 3600DN feels built to survive a busy office. The 350-sheet paper tray is sturdy and a handy gauge lets you know when paper is running low. Unusually at this price, you can add another 250- or 500-sheet cassette, for a maximum 850-sheet capacity.

This printer comes with a 20,000-page drum and a 1,500-page starter toner, after which toner replacements can be had with a 3,000- or 6,000-page capacity. Costs work out at just 1.2p per page with the bigger cartridge, or 1.3p if you include the maintenance box you'll need after 120,000 pages. We doubt many home users will get that far, but heavy users could buy this printer and produce 100,000 A4 pages for around £1,300.

We found the SP 3600DN quite slow to start printing unless its cooling fans were still running from a previous job, in which case the time to first page (TTFP) was about 16



seconds. Once the fans had stopped, it took 20-25 seconds. It made up for the hesitant start, though, printing our 25-page text test at 23.8ppm. Over 100 pages it reached 28.6ppm.

Text quality was excellent, with dark black characters and razor-sharp outlines. Graphics were also good, although the deep black toner made them too dark in places, and there was a trace of banding – common in laser printers. We saw the same issues with photos, but otherwise they were unusually good for this class of printer. Unfortunately, we couldn't print DL envelopes without creases appearing.

This printer is overkill for light home use, but its speed, durability, duplex printing and low costs make it ideal for anyone who wants to print a lot on a modest budget. The availability of paper tray upgrades means it could also grow with a small firm or business, so it wins our Business Buy award.

*Simon Handby*

### SPECIFICATIONS

TECHNOLOGY Mono LED • MAXIMUM PRINT RESOLUTION 1,200x1,200dpi • DIMENSIONS (HxWxD) 268x370x392mm • WEIGHT 14.5kg • MAXIMUM PAPER SIZE A4/Legal • WARRANTY Two years RTB • DETAILS [www.ricoh.co.uk](http://www.ricoh.co.uk) • PART CODE 906231

Normal speed

23.8ppm

Mono costs

1.2p

0% -50 Reference +50 +100

See page 72 for performance details



## 802.11AC WIRELESS UPGRADE KIT

# TRENDNET TEW-820AP



£25 inc VAT • From [www.dabs.com](http://www.dabs.com)

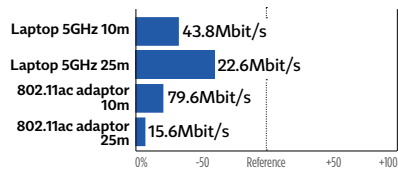
### VERDICT

A cheap way to add 802.11ac to your existing router, but the TEW-820AP isn't particularly quick

**IT'S SURPRISING HOW** few internet service providers bundle routers that support the faster 802.11ac wireless standard. Trendnet's TEW-820AP Wireless AC Easy-Upgrader is designed to help by upgrading your existing network to the standard. It also broadcasts 802.11n in 5GHz mode, which may give your network a boost if your ISP-provided router, such as the Sky Hub, is limited to 2.4GHz.

### SPECIFICATIONS

MODEM N/A • WI-FI STANDARD 802.11ac •  
STATED SPEED 433Mbit/s • USB PORTS 0 • WALL  
MOUNTABLE No • WARRANTY Three years RTB •  
DETAILS [www.trendnet.com](http://www.trendnet.com) • PART CODE TEW-820AP



The box is powered by Micro USB and plugs into your router with an Ethernet cable. By default, it broadcasts in mixed 802.11ac and 802.11n mode under its own SSID. The access point supports only 5GHz, but as your router still broadcasts its own Wi-Fi network, any 2.4GHz devices, such as older smartphones, can connect to that instead.

The tiny box has no external antennas and draws only a couple of watts from the mains, so we weren't expecting it to be a wireless powerhouse. In our tests, the TEW-820AP managed only 79.6Mbit/s at 10m when transferring files to and from a reference laptop fitted with a USB 802.11ac Wi-Fi adaptor. This fell to 15.6Mbit/s when we moved 25m away from the router. We're used to seeing well over 200Mbit/s from high-end 802.11ac routers at this distance, but these are five to 10 times the price of the TEW-820AP.

Using an 802.11n laptop in 5GHz mode, we saw 43.8Mbit/s at 10m, but a stronger 22.6Mbit/s at 25m. Again, these scores are far

slower than we've seen from dedicated routers but quicker than from a 2.4GHz-only Sky Hub, which managed a pitiful 17.2Mbit/s at 10m and 8.5MB/s at 25m.

The web-based interface is surprisingly thorough for such a basic device, with plenty of wireless, security and diagnostic settings. Here you can even put the TEW-820AP in reverse to turn a wired device into a wireless one – switching into Client mode lets you connect it to an existing wireless network to hook up a smart TV, games console or other gadget that lacks built-in Wi-Fi.

Upgrading your existing router's Wi-Fi is a nice idea, and at £25 the TEW-820AP is cheaper than buying a new 802.11ac router. However, it's barely any faster than a good 802.11n router. We'd be tempted to save up for a new router such as the TP-Link Archer C9 (see *Group Test, Shopper 331*) but if money is tight and you want to keep your current router, it's a reasonable choice.

Tom Morgan



## POWERLINE NETWORKING KIT

# NETGEAR PLP1200



£80 inc VAT • From [www.ebuyer.com](http://www.ebuyer.com)

### VERDICT

Reasonably priced and incredibly fast, the PLP1200 kit is as simple and effective as Powerline networking gets

**NETGEAR DOESN'T USUALLY** add pass-through sockets to its Powerline adaptors, but the PLP1200 breaks this trend, so you can enjoy the benefits of Powerline networking without sacrificing a socket.

With just a Gigabit Ethernet port and WPS security button on the top and a row of activity LEDs on the front, the PLP1200 is refreshingly simple. Multiple Ethernet ports

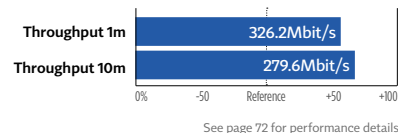
would have been welcome, but we can't grumble at this price for two adaptors. Each draws around 2W from the mains, so the PLP1200 shouldn't add more than 40p per month to your electricity bill.

Once you've plugged your adaptors into the mains and attached your wireless router, pairing is simply a matter of turning on each plug and pressing the security button. It takes less than a minute and you don't have to configure any software or browser interfaces.

The LED on the top changes colour to indicate your link rate. Green is best, suggesting 80Mbit/s or greater. Amber indicates a rate of between 50Mbit/s and 80Mbit/s, and Red means your connection is under 50Mbit/s. We didn't experience any connection problems in any of the sockets we tried in a two-bedroom flat, and with a claimed coverage area of 500m<sup>2</sup>, only the largest houses will pose a problem.

### SPECIFICATIONS

POWERLINE NETWORKING STANDARD HomePlug AV2 •  
STATED SPEED 1,200Mbit/s • ADAPTORS IN BOX 2 •  
WARRANTY Two years RTB • DETAILS [www.netgear.com](http://www.netgear.com) •  
PART CODE PLP1200-100UKS



The adaptors impressed us in our tests. With the plugs 1m apart, we saw a fantastic 326.2MB/s, although that isn't exactly indicative of real-world use. In our 10m test, however, the PLP1200 still produced an excellent 279.6MB/s – faster than any 802.11n wireless device and all but the very fastest 802.11ac Wi-Fi networks. Speeds eventually dropped to 74.6MB/s at 25m, but this is still a superb result.

There are no notable extras such as Wi-Fi or multiple Ethernet ports, but the PLP1200 is still reasonably priced for a Powerline starter set. Devolo's dLAN powerline 1200+ WiFi ac Starter Kit adds a second Ethernet port and 802.11ac Wi-Fi but costs twice as much. If you simply want to connect a single device to your network at high speed without using up all your plug sockets, the PLP1200 fits the bill.

Tom Morgan

## PCI EXPRESS SSD

# KINGSTON HyperX Predator PCIe SSD



£360 inc VAT • From [www.scan.co.uk](http://www.scan.co.uk)

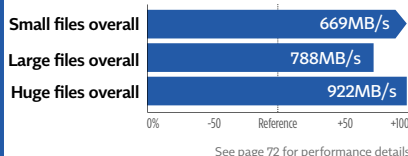
### VERDICT

Insanely fast and surprisingly good value – it's not the ultimate SSD, but it's as good as it gets for less than £400

**PCI EXPRESS-BASED** SSDs aren't new. OCZ, Plextor and Asus released disks in 2013 and 2014, but because they used similar two-lane PCIe 2.0 controllers, the speed advantages over SATA3 SSDs didn't justify the price. Kingston's first PCI-E SSD uses the new four-lane Marvell 88SS9293 controller, making it the first consumer-friendly SSD to break SATA3's bandwidth limits.

### SPECIFICATIONS

**CAPACITY** 480GB • **COST PER GIGABYTE** £0.75 • **INTERFACE** M.2/PCI Express • **CLAIMED READ** 1,400MB/s • **CLAIMED WRITE** 1,000MB/s • **WARRANTY** Three years RTB • **DETAILS** [www.kingston.com](http://www.kingston.com) • **PART CODE** SHPM2280P2H/480G



The HyperX Predator is essentially an M.2 SSD designed to use the PCI Express interface rather than SATA. The model we looked at comes with a PCI Express mounting bracket, so you can use it in a motherboard that lacks an M.2 slot and, even if it has one, ensures you get the best possible performance from the disk. This is because not all motherboards have dedicated PCI Express lanes for storage, but instead route them through the platform controller hub, or PCH, which shares bandwidth with other I/O controllers.

Kingston has used the M.2 2280 form factor to squeeze as many NAND modules on to the circuit board as possible. This puts it among the largest M.2 devices around, which could be a problem if you want to fit this SSD in a laptop. At least the HyperX Predator can be used as a boot disk, unlike other M.2 SSDs.

Compared with a 2½in SATA3 SSD, the HyperX Predator can reach much higher speeds. For large files, we saw write speeds of 715MB/s and read speeds of 862MB/s –

roughly twice the performance of most SATA3 SSDs. Read speeds were lower in our small files test at 622MB/s, but write speeds remained at 716MB/s.

It was in our huge files test that we saw the best performance. Write speeds of 884MB/s and read speeds of 961MB/s are faster than any SATA SSD. The only disk we've seen that's faster is Intel's £900 NVMe SSD.

The HyperX Predator is quicker than any SATA3 SSD purely because it isn't restricted by SATA's bandwidth. You need a free PCI-Express X4 slot or M.2 socket, however, making it unsuited to small or older motherboards. You also pay around twice the price of a traditional SSD, making this something of an odd stopgap between SATA and the faster NVMe. If you simply can't wait, this is one of the fastest disks around for less than £400, but you may be better off waiting for NVMe interfaces to become more common and for NVMe SSDs to drop in price.

Tom Morgan



## 2TB SSD

# SAMSUNG 850 EVO 2TB



£637 inc VAT • From [www.scan.co.uk](http://www.scan.co.uk)

### VERDICT

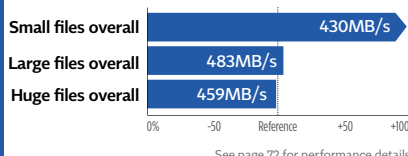
If you need loads of fast storage and multiple disks aren't an option, Samsung's 2TB SSD is your only choice

**SSDs CONTINUE TO** fall in price, but storage capacity remains a concern. Most SATA SSDs top out at 1TB, so you'll almost certainly need a second mechanical hard disk if you want to guarantee you won't run out of space.

That's not the case with Samsung's latest 850 EVO SSD – the first consumer SSD with 2TB of storage. The new disk joins the existing 850 EVO range but adds a few tweaks. The

### SPECIFICATIONS

**CAPACITY** 2TB • **COST PER GIGABYTE** £0.32 • **INTERFACE** SATA3 6GB/s • **CLAIMED READ** 540MB/s • **CLAIMED WRITE** 520MB/s • **WARRANTY** Five Year RTB • **DETAILS** [www.samsung.com/uk](http://www.samsung.com/uk) • **PART CODE** MZ-75E2T0B/EU



2TB 850 EVO has a custom Samsung MHX flash memory controller, which is an upgraded version of the MEX controller found on the 1TB model. It also has 2GB of DDR3 cache, which Samsung says helps the 2TB model to deliver the same 540MB/s and 520MB/s read and write speeds as the 1TB disk.

We couldn't quite verify those lofty claims in our storage benchmarks, but the 850 EVO still impressed us with its speed. In our huge files test, which copies files several gigabytes in size, we saw an average write speed of 471.1MB/s and average reads of 446.1MB/s.

Although its read speeds of 446.1MB/s were marginally slower in our large files test, which uses a folder filled with 100MB High Resolution music tracks, write speeds were faster at 519.4MB/s. This is approaching the 550MB/s bandwidth ceiling of SATA3, so you're unlikely to see faster speeds without switching to a different interface such as NVMe. If performance is your priority a

PCI Express SSD such as Intel's 750 series 1.2TB is still your best bet – although you pay almost three times as much for such high speeds.

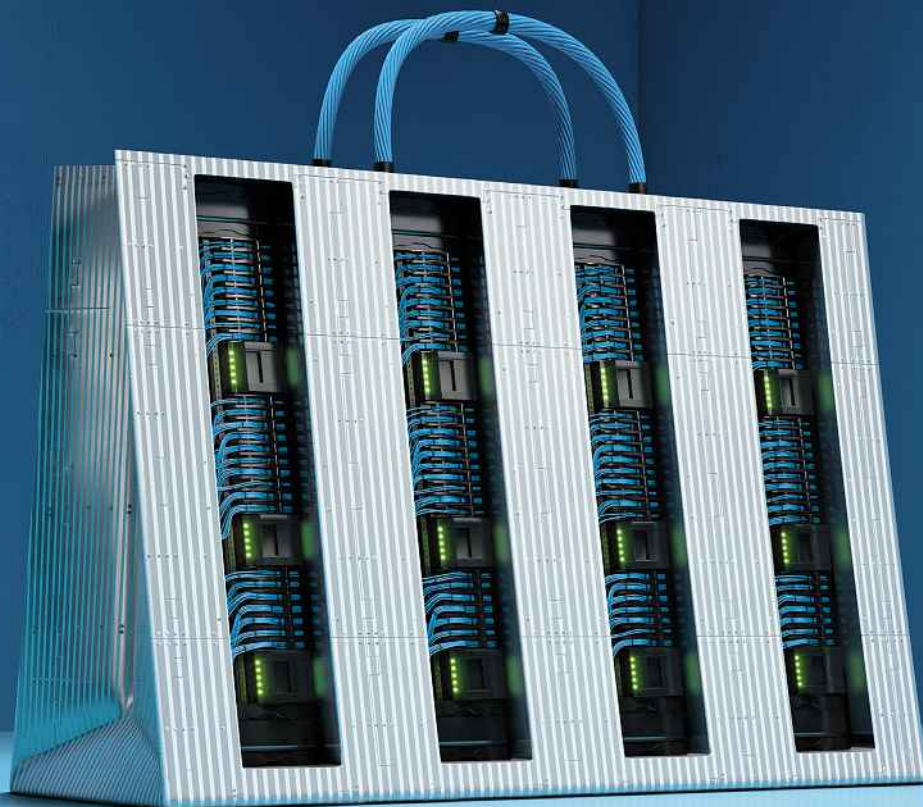
We saw similar write speeds in our small files test, which uses several gigabytes of 5MB image files. Its score of 514.7MB/s in our write test is very impressive. SSDs are always slower when reading lots of small files, but 345MB/s is an excellent result.

The 850 EVO could prove popular with gamers who want to cut down on loading times or anyone running a home theatre or mini-ITX PC. At £637 it's more expensive than most consumer SSDs, but when the only other 2TB SSDs are enterprise-class models costing £2,000 or more, it's surprisingly good value. Two 1TB 850 EVO SSDs would be cheaper at around £580, but if you want the most storage possible from a single disk, the 850 EVO 2TB is absolutely worth the money.

Tom Morgan







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## MID-RANGE GRAPHICS CARD

# XFX Radeon R9 380 4GB

COMPUTER  
SHOPPER  
RECOMMENDED



£174 inc VAT • From [www.scan.co.uk](http://www.scan.co.uk)

### VERDICT

A new mid-range bargain for AMD, but the ageing architecture isn't the leap forward we were hoping for

**AMD'S GRAPHICS CARDS** have always provided impressive performance for the money, but with most of its cards being based on three-year-old architecture, many gamers searching for a powerful card have turned to Nvidia's GeForce GTX 980 and its newer, more energy-efficient Maxwell architecture.

AMD fans have been waiting for a new GPU for a long time, but sadly the Radeon R9 380 isn't the all-new silicon we were hoping for; that's reserved for the top-end Fury and Fury X, two seriously powerful cards designed for 4K gaming. The R9 380, like the rest of the 300-series range, is more of a mid-range card, built around the Graphics Core Next architecture that first arrived in 2012.

### ALL GONE PETE TONGA

The Tonga GPU core seen here is effectively a rebadged, slightly higher-clocked version of the chip used by last year's Radeon R9 285, which itself was a modified version of the graphics chip used in the Radeon HD 7950 with Boost GPU released in 2012. With 1,792 stream processors, 112 texture units and 32 ROPs, the only thing differentiating the R9

made the switch from the 384-bit memory bus seen in the HD 7950 with Boost to a narrower 256-bit bus here. However, with the memory clocked at a higher 5.5Gbit/s, the actual memory bandwidth has increased overall, meaning the new card should still outperform older models.

### BREATH OF AIR

The XFX Double Dissipation edition R9 380 we looked at has a twin-fan, four-heatpipe cooling system that connects directly to the GPU core and vents hot air out into the case.

It all works well, keeping the GPU below 40° when at idle without making a sound. It may not stop the fans completely when you're on the Windows desktop, as Nvidia's GeForce GTX 960 manages, but the XFX card's fans spin so slowly under light load that it was impossible to hear them over the other fans in our reference system. We would hardly call them loud when gaming, either.

## The R9 380 will outperform the similarly priced Nvidia GeForce GTX 960 in many titles

380 from the R9 285 is its slightly faster 970MHz boost clock speed. AMD doesn't tend to reveal core, as opposed to boost, clock speeds, and third-party manufacturers are free to overclock their own AMD-based cards to higher speeds, often using custom coolers to help them do so.

It may have a higher boost clock, but the R9 380 draws an identical amount of power to the R9 285. A claimed 190W average under load is a definite improvement over previous AMD cards, which were notorious for running hot and needing plenty of juice, but it still falls short of the Nvidia competition. The GeForce GTX 960, the R9 380's closest rival, draws only a claimed 120W. You'll need two six-pin PCI-Express connectors to power the card.

The R9 380 is available with both 4GB and 2GB of VRAM. The 2GB version is around £20 cheaper, but we think this is a false economy, as modern games such as Batman: Arkham Knight need at least 3GB. More VRAM also makes a big difference when you start gaming at resolutions higher than 1080p. AMD has

XFx has overclocked the GPU boost clock to 990MHz and pushed the memory clock to 5,700MHz – increases of 20MHz and 200MHz respectively over the reference R9 380. These fairly modest bumps show that AMD is approaching the limit of its GPU architecture; we struggled to eke out much more speed when overclocking our review sample manually.

The card has two dual-link DVI outputs, a single HDMI and a DisplayPort 1.2 video output on the rear. Frustratingly, all 300-series graphics cards, and indeed the Fury and Fury X, make do with HDMI 1.4a video outputs. This makes them less than ideal for hooking up to a 4K TV, as you'll be limited to a 30fps refresh rate; we prefer 60fps for properly smooth gaming, and Windows Desktop applications are jerky at less than 60fps.

The R9 380 didn't disappoint at 1,920x1,080. In Dirt Showdown we saw a silky smooth 86.9fps, along with 49.9fps in Tomb Raider with the demanding supersampling anti-aliasing (SSAA) turned on. Swapping SSAA for the less resource-hungry FXAA

resulted in a superb 102.8fps.

Even the demanding Metro: Last

Light Redux was playable at maximum detail, with an average 30.4fps. Again, disabling SSAA boosted the frame rate considerably to 55.4fps.

The R9 380 trades blows with Nvidia's GeForce GTX 960 at 1,920x1,080, where the extra 2GB of VRAM doesn't make much of a difference to frame rates, but stepping up to 2,560x1,440 reveals more of a performance gap. The R9 380's 67.3fps in Tomb Raider, with maximum detail and FXAA enabled, is an excellent result, beating the GTX 960 by 20%. There was a much smaller gap in Metro, however, with both cards averaging 34fps.

It was only when we increased the resolution to 3,840x2,160 that the R9 380 began to struggle. Dirt Showdown still produced a playable 37.6fps, and even Tomb Raider ran at a borderline 30.9fps, but Metro dropped to a choppy 15.6fps.

### QUITE A PERFORMANCE

It may not be entirely new, but there's no doubting the R9 380's performance. It will outperform the similarly priced Nvidia GeForce GTX 960 in many titles, comfortably cope with any game at 1,920x1,080 and even manage smooth frame rates at 2,560x1,440.

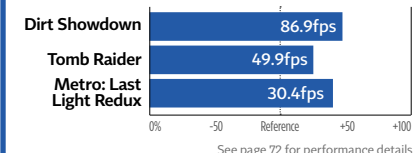
Unfortunately, while the faster clock speed and extra memory give it a slight edge over the R9 285, there's very little to differentiate the R9 380 from its predecessor. If you'll be sticking to 1,920x1,080 or 2,560x1,440 gaming for the foreseeable future, the R9 380 will be more than sufficient for playing new games, but if you only recently upgraded to a 200-series graphics card there's no reason to make the jump to AMD's new model.

Tom Morgan



### SPECIFICATIONS

GPU AMD Radeon R9 380 • MEMORY 4GB GDDR5 • GRAPHICS CARD LENGTH 234mm • WARRANTY Two years RTB • DETAILS [www.xfxforce.com](http://www.xfxforce.com) • PART CODE R9-380P-4DF5



See page 72 for performance details



RT-AC3200 Tri-Band Wireless Gigabit Router

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## IMAGE-EDITING SOFTWARE

# ADOBE Creative Cloud Photography Plan

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### VERDICT

The subscription model might be annoying, but Photoshop and Lightroom for £102 a year is a bargain

**ADOBE PHOTOSHOP IS** possibly the world's best-known software application, which is quite an achievement considering how few people own it. Photoshop CS6 cost a huge £667, but since June 2013 Photoshop has only been available as part of a Creative Cloud subscription. Initially it cost £17 a month, or £46 a month for the complete set of Adobe creative applications, but after various twists and turns it's now available along with Lightroom for £8.57 a month. This is based on an annual subscription, so £102 a year.

It's not cheap, but it works out about the same as paying £200 every couple of years to upgrade Photoshop CS to the latest version. On the plus side, there's no longer an initial outlay to fork out. Another significant plus is the inclusion of the fantastic Lightroom (see *Reviews, Shopper 330*), which remains available to buy for £104, and £59 to upgrade every couple of years. Subscribers also get access to Lightroom for iPad and Android devices, which serves as a useful partner app for the desktop application. Subscribers can install applications on two computers, and there's 20GB of cloud storage thrown in too.

The downside is that you can't choose to skip an upgrade if it doesn't appeal or if finances are tight – cancel the subscription and the software disappears. There's nothing you can do if Adobe decides to raise the price significantly, so while £8.57 a month might not sound much, it's not something that should be entered into lightly.

The bottom line is this: what does the Creative Cloud Photography Plan offer that Adobe Photoshop Elements (see *Reviews, Shopper 323*) lacks, and is it worth taking the plunge? Elements costs £60 to buy but

bizarrely £65 to upgrade from the previous version. With updates released yearly, it isn't much cheaper than a £102-per-year subscription. However, with Photoshop Elements you don't have to keep paying if you decide you don't need the latest version.

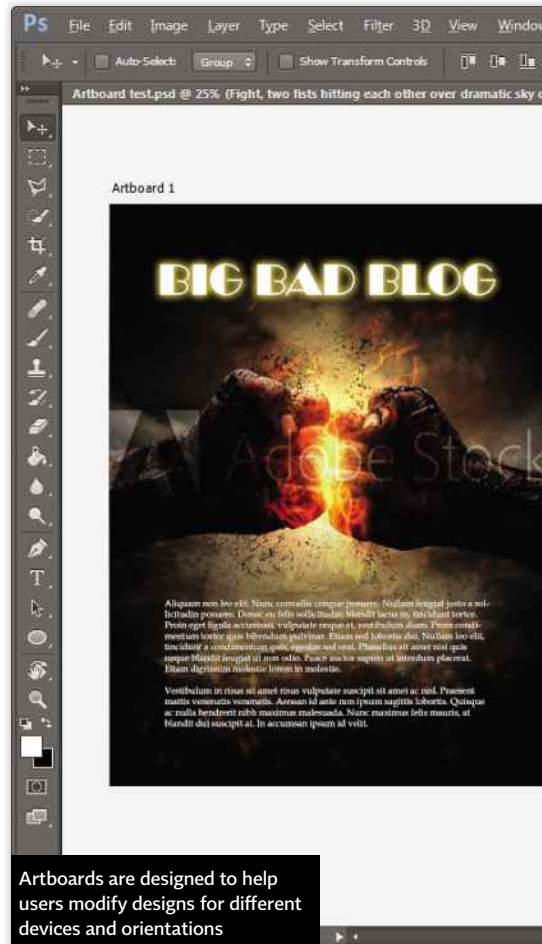
### RAW DEAL

One reason to keep editors up to date is for their Raw processing. Adobe has the widest support for cameras' Raw files of any software publisher, but for the latest cameras you'll need the most recent version of the software.

The underlying Raw-processing engine is shared across Photoshop CC, Lightroom and Elements, and the quality of colour correction, noise reduction and sharpening is first rate. There's huge scope to reveal details that are absent in cameras' JPEG output, especially in highlights and shadows, and to perform dramatic colour processing while maintaining pristine quality. Lightroom builds these tools into its elegant photo-management interface, while Photoshop CC users can choose whether to use Lightroom or the simpler Adobe Bridge module. The Photoshop Elements Organizer module isn't as capable or as polished, but does the job.

Photoshop CC includes various Raw-processing tricks not offered by Elements; it's essentially the full suite of tools found in Lightroom's Develop tab. These include the ability to apply adjustments to limited parts of the frame using linear and radial gradients, and an Adjustment Brush.

Elements users can achieve similar results after importing the image into the main editing environment, but image quality may suffer. As soon as a Raw (or any other) file is



Artboards are designed to help users modify designs for different devices and orientations

brought into Elements' main editor, it's converted to 8-bit-per-channel colour. This won't be immediately noticeable (monitors are 8-bit too), but further heavy colour correction may reveal colour banding or lost highlight and shadow detail.

There's nothing in Elements to match Photoshop CC and Lightroom's curve-based colour correction or their ability to adjust the hue, saturation and luminance of specific colours. A new Dehaze feature boosts the contrast of low-contrast parts of the frame while leaving other areas relatively unscathed. It's a little crude, with just a single Amount slider, but it's a valuable addition nonetheless.

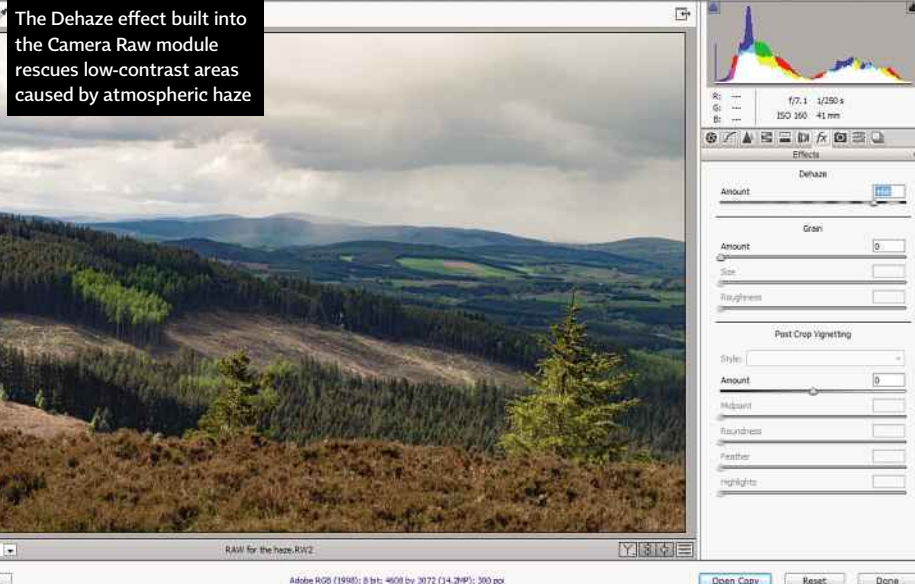
Photoshop Elements is highly adept at Raw processing, but we really appreciate Photoshop CC and Lightroom's extra surgical precision and superior library management.

### ALTERED IMAGES

Photoshop is most famous, or perhaps infamous, for its ability to alter images while maintaining photorealism. Recent Photoshop CC updates have introduced Content-Aware Move and Patch tools that can move or remove elements and repair the photo automatically. They're handy for a quick fix but they rarely produce convincing results.

One automated tool we find really useful is the Healing Brush, which clones areas of a photo while blending colours with their new surroundings. The Spot Healing Brush in Content Aware mode is also great for removing blemishes over complex textured areas. All these tools are included in Photoshop Elements too, so there's little to choose between them for photo retouching. Lightroom makes a decent stab at retouching

The Dehaze effect built into the Camera Raw module rescues low-contrast areas caused by atmospheric haze







but as it's not a layer-based editor, we'd only use it for simple fixes, such as removing lens dust spots or a piece of litter from a scene.

Certain creative edits are handled better by Photoshop CC than Elements. Both editors include the Liquify tool for pushing pixels around the frame, but Photoshop CC's implementation includes extra controls and vastly more responsive screen redraws.

Photoshop CC also wins hands down for creative blur functions, with a suite of sophisticated filters that simulate depth-of-field effects, tilt-shift lenses and motion blur. New to the 2015 CC update is the ability to add noise to blurred areas so they match the unaffected areas, giving the impression that the blur happened in-camera.

## GRAND DESIGN

Photoshop is used for design tasks as much as for editing individual images, but it's not ideally suited to this role. Being a destructive bitmap editor, frequently adjusting the size of images will degrade the fidelity of details as the pixels are repeatedly resized.

That's not necessarily the case in Photoshop CC, though. Smart Objects mean that imported bitmaps link back to the source files, so repeated resizing doesn't diminish quality. It's not infallible and requires a fair bit of care to avoid breaking the links. However, it's conspicuously absent from Photoshop Elements. Another key feature that's available in Photoshop CC but not Elements is CMYK export, something that's required by most professional printing bureaux.

Various new features in Photoshop CC 2015 further enhance its aptitude for design tasks. Adobe Stock, a stock image library of

40 million images, is integrated into various Creative Cloud applications, including Photoshop. Searching the library still happens in a web browser, but a couple of clicks will put a watermarked copy of an image in Photoshop's Libraries panel. This can be used in a project and automatically replaced with a high-resolution, non-watermarked copy if you choose to purchase it.

Images cost £7.20 inc VAT each, with monthly subscriptions costing £24 for 10 images, based on a yearly contract. Rival libraries may be cheaper, but we appreciate the simplicity of Adobe Stock's prices.

The new Artboards feature sees Photoshop venturing into multi-page documents for the first time. It's primarily intended for web and app design, with preset resolutions for mobile devices and computer monitors. It's useful for working on portrait- and landscape-orientation designs

simultaneously, or to customise layouts for popular devices' screens. Edits to individual layers can be reflected across multiple Artboards through the use of Smart Objects, but it's a clunky approach that means assets must be saved as individual files and can't be edited in situ, which somewhat defeats the benefit of keeping multiple Artboards in the same PSD file.

Exports are as individual Artboards in a range of image formats, or the whole lot as a multi-page PDF. Adobe InDesign is better equipped for this, but Photoshop can handle newsletters and brochures a lot better than Microsoft Word.

## BUY OR SUBSCRIBE?

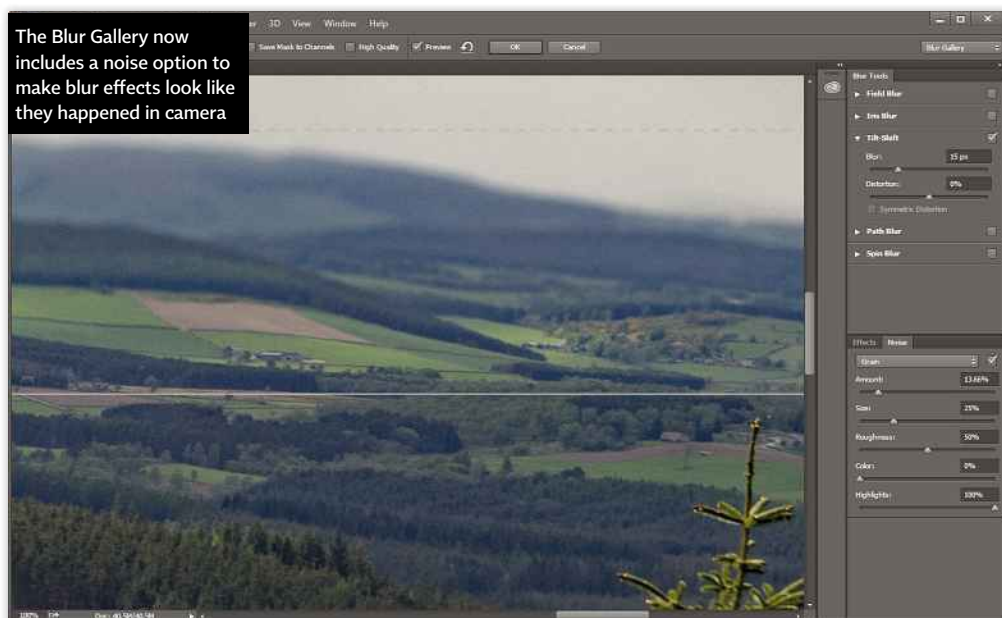
As we see it, there are three options: buy Photoshop Elements for £60, buy Lightroom for £104 or subscribe to Creative Cloud Photography Plan for £102 per year. Other image-editing software is available, of course, but none that we've used poses much of a threat to Adobe's software. The one exception is DxO OpticsPro ([www.dxo.com](http://www.dxo.com)), which is an accomplished rival to Lightroom.

People who simply want to organise and optimise photos but who aren't interested in creative editing should buy Lightroom. Its elegant interface makes light work of managing Raw files and it has a superb set of carefully tailored editing tools. For advanced photo retouching and editing and graphic design tasks, there are lots of little reasons, and a few big ones, why Photoshop CC is superior to Elements. For us it easily justifies the higher price. It may seem more daunting for new users, but once you've grasped a few key concepts you should find it straightforward and elegant. We suspect that Photoshop CC, with Lightroom as its wingman, will quickly prove its worth.

Ben Pitt

## SPECIFICATIONS

**OS SUPPORT** Windows 7 (SP1)/8.1, Mac OS X 10.9/10.10 • **MINIMUM CPU** Intel Core 2 or AMD Athlon 64 processor, 2GHz • **MINIMUM GPU** OpenGL 2.0, 512MB RAM (1GB recommended) • **MINIMUM RAM** 2GB (8GB recommended) • **HARD DISK SPACE** 2.1GB • **DETAILS** [www.adobe.com/uk](http://www.adobe.com/uk)



## MUSIC-PRODUCTION SOFTWARE

# STEINBERG

## Cubase Elements 8

COMPUTER  
SHOPPER

★★★★★

RECOMMENDED £69 inc VAT per year •

From [www.dawsons.co.uk](http://www.dawsons.co.uk)

### VERDICT

Sophisticated and complex, Cubase Elements is tremendous value, but not for everyone

**THERE'S A WIDE** range of superb music-production software available, but Steinberg Cubase is the one we turn to for our own recording projects. It's elegant, reliable and packed with useful features. It's particularly strong for recording, editing and mixing live instruments, but there's also a generous supply of virtual instruments and MIDI editing tools for generating sounds inside the software.

Cubase Elements is the entry-level version, below Cubase Artist (£199, *Shopper* 326) and Cubase Pro (£369). It shouldn't be mistaken for consumer-orientated software, though. It's essentially the same software, just with various advanced features, effects and virtual instruments stripped out. There's no attempt to tailor the interface for less experienced users.

Cubase Artist 8 was given a stunning performance boost by ASIO Guard 2, so we're delighted to find it included in Elements. It's a reworked version of the engine that enables the software to run multiple tracks, mixer channels, effects and virtual instruments without overloading the computer's hardware resources and causing audio glitches. ASIO Guard 2 is better at looking ahead and predicting where spikes in processor, RAM or disk demands will occur, and starts working on them earlier to avoid system overloads.

We saw massive improvements when testing Cubase Artist on a desktop PC, so we installed Cubase Elements on a laptop to see if ASIO Guard 2 delivered similar results. Sure

enough, projects that were prone to glitches with ASIO Guard disabled played back smoothly with it turned on, with the software's built-in performance meter falling from around 90 to 50 per cent. The transformation is more in line with what we'd expect from upgrading to a new PC rather than updating software. As such, Cubase Elements 8 immediately qualifies as an essential update for existing users. The £18 upgrade price is extremely reasonable, too.

### GROOVE IS IN THE HEART

The virtual instrument bundle has been updated to include Groove Agent SE 4, a drum machine that allows deeper editing than the outgoing Groove Agent One. Options to apply envelopes and randomness to samples' pitch may be beyond the needs of most Cubase Elements users but it's great for more technically minded people. It's disappointing the Acoustic Agent sounds aren't included, though – these are the best part of Groove Agent SE 4 as it appears in Cubase Artist and Pro. It's also annoying that Groove Agent One has disappeared. It will still be in the plug-in folder for those who upgrade from version 7, but after a clean install our old projects that used Groove Agent One didn't load properly.

Some people will have the opposite problem, whereby the plug-in folder is filled with effects and instruments they don't want. The new Plug-in Manager helps to resolve

this, letting users create custom lists of their favourite plug-ins. The Instrument Rack is a new docked panel for managing virtual instruments, and consolidates a slightly disjointed approach in previous versions. The same panel can also show the MediaBay for managing recordings and sample libraries. Showing and hiding this or other docked panels is far harder than it should be, though. Other improvements include the ability to define EQ frequencies as musical notes rather than in Hertz, and to adjust the steepness of slopes of the high-pass and low-pass filters.

If that last sentence means nothing to you, it's indicative of how Steinberg has made no attempt to accommodate less technical users. They can ignore the more advanced features, of course, but it can be hard to find what you need in among the mass of cryptic icons and labels. Configuring the software to work with audio hardware is far from simple. The Quick Start manual covers this in some detail, but the 686-page manual isn't exactly light reading.

### MOTHERS OF INVENTION

In Steinberg's defence, Cubase's jargon and complexity aren't the company's inventions. These are the terms and techniques that sound engineers understand. They will be baffling to some but others will appreciate having a professional-level application at such an attainable price. We prefer Cubase Elements to Cakewalk Music Creator 7 (*Shopper* 329), which attempts to marry advanced and beginner-friendly features but falls short in both areas. For beginners who want to keep things simple, Steinberg Sequel 3 (*Shopper* 289) is still our top recommendation.

For more ambitious users, Cubase Artist offers more audio and MIDI tracks, group channels, inputs and outputs, higher-quality pitch-shifting and time-stretching plus an extended set of virtual instruments and effects. We suspect Cubase Artist will be a better fit for these users, but if funds are tight, Cubase Elements is a great place to start.

Ben Pitt



The new docked panel for VST instruments helps Cubase fit on to a single monitor – just about



Groove Agent SE4 is a drum machine with huge scope for manipulating its library of sampled drum kits

### SPECIFICATIONS

**OS SUPPORT** Windows 7/8.x, Mac OS X 10.9/10.10 • **MINIMUM CPU** Intel Core or AMD dual core • **MINIMUM GPU** 1,366x768 minimum resolution • **MINIMUM RAM** 4GB (8GB recommended) • **HARD DISK SPACE** 15GB • **DETAILS** [www.steinberg.net](http://www.steinberg.net)



# WI-FI

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Email: [sales@devolo.co.uk](mailto:sales@devolo.co.uk)

**devolo**  
The Network Innovation

## SUPERHERO ADVENTURE

# WARNER BROTHERS Batman: Arkham Knight

COMPUTER  
SHOPPER



RECOMMENDED £29 inc VAT • From [www.zavvi.com](http://www.zavvi.com)

### VERDICT

Arkham Knight brings Gotham to life like never before, and takes Batman to seriously dark places

**ARKHAM KNIGHT WAS** billed as the final chapter to the Arkham series of games – arguably some of the best comic book adaptations we've played. Expectations were high, but developer Rocksteady hasn't just delivered; it has crafted one of the most absorbing, intelligent breakdowns of what makes Batman the man he is, and what force could ever be strong enough to put an end to his journey. We just weren't prepared for how much of a dark journey it would be.

The entire game takes place in the course of a single night, with Gotham evacuated after Scarecrow threatens to unleash a toxic attack on the city. Only thugs, convicts and the most famous faces from Batman's rogues gallery remain, roaming the streets and causing chaos while you try to save Gotham's police officers that stayed to help.

It sounds straightforward enough, but the addition of the mysterious Arkham Knight, a mercenary who somehow knows Batman's deepest secrets (a recurring plot from Arkham City we can't expand on for fear of spoiling the surprise) and haunting flashbacks from Batman's past all add up to a multilayered story with some wildly dark twists that even fans of the comics won't see coming.

Batman might have free rein to explore his city, but you don't have to do it on foot; the Batmobile makes its first appearance in an Arkham game, and what an appearance it is. Taking heavy inspiration from Christopher Nolan's Tumbler, Rocksteady's take on the iconic car is big, black and brutal. You can smash through obstacles as you drive through Gotham's streets, and as long as

you can see the road you can call the car to you, even landing in the cockpit from a glide if you call it while in the air.

In tank mode it becomes an entirely different beast. The wheels rotate 90° and give you full freedom of movement, while a gun turret emerges from the top to help you take down more powerful opponents.

We think the Batmobile almost outstays its welcome, however; most of the optional side missions use it to some degree, with more traditional stealth and combat often taking a back seat to driving. The car feels oddly light and oversteers wildly when driving at speed, which is totally out of character for a heavily armoured vehicle.

### RADIO HEAD

There's a huge number of missions and optional objectives to tackle, many of which let you explore on foot, but thankfully they don't litter the map – instead local radio chatter alerts you to nearby missions as you approach them. We felt most at home using the Batclaw to soar high into Gotham's skies, gliding between missions and sticking to the shadows. Hiding in air ducts and hanging from the side of buildings lets you take down enemies, avoiding combat till you get spotted.

Fights are guaranteed to happen eventually, though. Combat feels largely familiar to the previous Arkham games, with a mix of attacks, blocks and counters making each encounter feel like a free-flowing brawl rather than a series of individual fights. However, the multiple new enemy types make combat feel a lot fiddlier this time around. We

liked having to focus on medics, who can bring incapacitated grunts back into the fight, but having to make liberal use of the Batclaw, electrical charge and explosive gel to counter specific enemy types gets messy very quickly.

The addition of computer-controlled allies, and the ability to take control of them at any time during a fight, is a welcome addition, however. Catwoman, Nightwing and Robin all

get involved at various points, each with their own unique moves and abilities to add some variety. These are fleeting moments, however, and for the most part you're on your own.

The puzzle-solving elements are mostly resigned to the Riddler's optional missions too, with only one or two major set pieces forcing you to experiment with Batman's gadgets.

### GOTHAM CONDENSED

Ultimately though, there's much fun to be had gliding through the city simply being Batman. Gotham is huge, and looks absolutely stunning, with rain dripping convincingly off Batman's cowl as he perches on ledges, and buildings crumbling as you crash through them with the Batmobile. Neon lights glow convincingly and the character models are impressively detailed – and that's all despite running on a previous version of the Unreal engine. The PS4 and Xbox One versions of Arkham Knight are a stunning example of what's possible with the hardware; everything is open and accessible, with no mid-game loading screens at all. It's a shame the same can't be said about the PC version, at least at the time of writing – the publisher has pulled the game from sale following major performance issues. There's no word on when it will be fixed, either, meaning at the time of writing a console is the only way to play.

Arkham Knight may not introduce many new gameplay elements to the series, Batmobile aside, but the masterful story, willingness to go places the comics have yet to tread, and the addition of new characters breathes new life into the formula. Gotham is hauntingly beautiful, filled with life and a genuine joy to explore, either on foot, on four wheels or from the sky. The intricate and intense story shines a new light on Batman that will genuinely surprise even the most ardent of fans. It's a shame the PC version is so broken at the moment, but console gamers should snap this up right away.

Tom Morgan

### SPECIFICATIONS

**AVAILABLE FORMATS** PC, Xbox One, PS4 • **OS SUPPORT** Windows 7, Windows 8.1 64-bit • **MINIMUM CPU** 2.67GHz quad-core Intel, 3.4GHz quad-core AMD • **MINIMUM GPU** AMD Radeon R9 270 3GB, Nvidia GeForce GTX 660 • **MINIMUM RAM** 6GB • **HARD DISK SPACE** 45GB • **DETAILS** [www.batmanarkhamknight.com](http://www.batmanarkhamknight.com) • **PRODUCT CODE** 10924820



The Batmobile might be a brute, but it's a rocket when you activate the afterburners

Gliding above the chaos is still a highlight, especially when Gotham looks so pretty





# How 3D-printed rats could offer schools a vegetarian dissection

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A fresh take on technology

## Choosing a ...

### Laptop computer

**01** A basic laptop costing around £300 will run everyday office, multimedia and education software, but it won't be suitable for 3D gaming. Many laptops at this price have a 15.4in screen and weigh around 2.4kg, so they're best used around the house and for occasional journeys.

**02** If you want to play modern games, you'll need a laptop that has a dedicated graphics chip such as the Nvidia GeForce GTX 860M. Good gaming laptops tend to have large 17in screens and weigh around 3kg, so they're best suited to the home.

**03** If you want a laptop that you can take everywhere, look for a model that weighs less than 2kg. For the best portability, look for one with an 11in or 13in screen. In general, the smaller and lighter the laptop, the more expensive it is, especially if you want a model with plenty of processing power.

**04** Battery life is extremely important for a laptop. We'd expect all but the biggest and heaviest to last for at least five hours on a single charge, but for an ultra-portable that you carry everywhere, eight hours and above is more desirable.

**05** Laptops use the mobile versions of processors to conserve power, and these lag behind desktop chips for performance. For a budget laptop, an Intel Core i3 processor will do the job, but if you want better performance, look for an Intel Core i5 or Core i7 model instead. We recommend a minimum of 4GB of RAM, although 8GB is better for multitasking.

**06** Most budget and mid-range laptops have a regular hard disk for storage. You want at least 500GB, but 1TB or more is better. SSDs have faster performance, making your computer much quicker to boot. SSD capacity is lower, though, and you'll need at least 128GB.

**07** Netbooks are a type of small, low-cost ultra-portable laptop. They're fine for light use, but avoid them if you want to do complicated tasks.

### PCs



#### CHILLBLAST Fusion Raptor



£1,129 inc VAT • [www.chillblast.com](http://www.chillblast.com)

The Chillblast Fusion Raptor comes in a gorgeous case and manages to successfully marry great application performance and scintillating gaming gusto. It uses some impressive components and is great value.

**PROCESSOR** Quad-core 4.4GHz Intel Core i7-4790K (overclocked) • **RAM** 16GB • **FRONT USB PORTS** 2x USB3 • **REAR USB PORTS** 2x USB, 4x USB3 • **TOTAL STORAGE** 120GB SSD, 2TB hard disk • **GRAPHICS CARD** 2GB MSI GeForce GTX 960 Gaming 2G • **DISPLAY** None • **OPERATING SYSTEM** Windows 8.1 • **WARRANTY** Five years (three years collect and return, two years RTB) • **DETAILS** [www.chillblast.com](http://www.chillblast.com) • **PART CODE** Fusion Raptor • **FULL REVIEW** May 2015



#### ACER Revo One RL85



£370 inc VAT • [www.pcworld.co.uk](http://www.pcworld.co.uk)

One of the cleverest PC designs we've seen in ages, the tiny Acer Revo One has enough space for three high-capacity hard disks, making it a perfect living-room PC. With an Intel Core i3 processor, it's no slouch either, and the price is as attractive as the chassis.

**PROCESSOR** Dual-core 1.7GHz Intel Core i3-4050U • **RAM** 4GB • **FRONT USB PORTS** 0 • **REAR USB PORTS** 2x USB, 2x USB3 • **TOTAL STORAGE** 2TB hard disk • **GRAPHICS CARD** Integrated Intel HD 4000 graphics • **OPERATING SYSTEM** Windows 8.1 • **WARRANTY** One year RTB • **DETAILS** [www.acer.co.uk](http://www.acer.co.uk) • **PART CODE** DT.SZMEK.014 • **FULL REVIEW** Aug 2015



#### PALICOMP i5 Devil Blaster



£700 inc VAT • [www.palicmp.co.uk](http://www.palicmp.co.uk)

Palicomp has created an eminently powerful system for the money. The i5 Devil Blaster has terrific gaming performance and the system's overclocked i5-4690K processor provides great application performance. A decent monitor rounds off a great-value system.

**PROCESSOR** Quad-core 4.5GHz Intel Core i5-4690K (overclocked) • **RAM** 8GB • **FRONT USB PORTS** 1x USB3, 1x USB • **REAR USB PORTS** 4x USB3, 2x USB • **TOTAL STORAGE** 1TB hybrid hard disk • **GRAPHICS CARD** 2GB PowerColor AMD Radeon R9 270X • **DISPLAY** 24in Iiyama ProLite E2483HS • **OPERATING SYSTEM** Windows 8.1 • **WARRANTY** Three years RTB, one year parts • **DETAILS** [www.palicmp.co.uk](http://www.palicmp.co.uk) • **PART CODE** HAS8 • **FULL REVIEW** Dec 2014



### LAPTOPS



#### ASUS ZenBook UX305



£650 inc VAT • [www.johnlewis.com](http://www.johnlewis.com)

The UX305 is Asus's first laptop that runs Intel's new low-power Core M processors. Weighing just 1.2kg and 12mm thick, it's one of the thinnest and lightest laptops we've ever tested. Its performance won't set the world alight, but if you're after a portable work machine, look no further.

**PROCESSOR** Dual-core 800MHz Intel Core M-5Y10C • **RAM** 8GB • **SIZE** 324x226x12mm • **WEIGHT** 1.2kg • **SCREEN SIZE** 13.3in • **SCREEN RESOLUTION** 1,920x1,080 • **GRAPHICS ADAPTOR** Intel HD 5300 • **TOTAL STORAGE** 128GB SSD • **OPERATING SYSTEM** Windows 8.1 • **PARTS AND LABOUR WARRANTY** One year collect and return • **DETAILS** [www.asus.com](http://www.asus.com) • **PART CODE** UX305FA(MS)-FC061H • **FULL REVIEW** Jun 2015



#### SCAN 3XS Graphite LG157



£880 inc VAT • [www.scan.co.uk/3xs](http://www.scan.co.uk/3xs)

Scan has created a successful follow-up to its Graphite LG156 with an excellent screen and build quality improvements. You also get a generous two-year warranty, making the Graphite LG157 a great choice.

**PROCESSOR** Quad-core 2.5GHz Intel Core i7-4710HQ • **RAM** 8GB • **SIZE** 385x268x29mm • **WEIGHT** 2.5kg • **SCREEN SIZE** 15.6in • **SCREEN RESOLUTION** 1,920x1,080 • **GRAPHICS ADAPTOR** Nvidia GeForce GTX 960M • **TOTAL STORAGE** 120GB SSD, 1TB hard disk • **OPERATING SYSTEM** Windows 8.1 • **PARTS AND LABOUR WARRANTY** Two years RTB • **DETAILS** [www.scan.co.uk/3xs](http://www.scan.co.uk/3xs) • **PART CODE** 3XS Graphite LG157 • **FULL REVIEW** Aug 2015



#### TOSHIBA Chromebook 2 (CB30-B-104)



£270 inc VAT • [www.pcworld.co.uk](http://www.pcworld.co.uk)

Toshiba's Chromebook 2 is the first budget Chromebook on sale in the UK with a Full HD screen. This increases the price a little but we think it's absolutely worth it. With so much extra real estate, you can fit more items on the screen and get more done. The machine is lighter and has better battery life than its predecessor, too, making it our current favourite Chromebook.

**PROCESSOR** Dual-core 2.16GHz Intel Celeron N2840 • **RAM** 4GB • **SIZE** 320x214x19mm • **WEIGHT** 1.35kg • **SCREEN SIZE** 13.3in • **SCREEN RESOLUTION** 1,920x1,080 • **GRAPHICS ADAPTOR** Intel HD Graphics • **TOTAL STORAGE** 16GB SSD • **OPERATING SYSTEM** Google Chrome OS • **PARTS AND LABOUR WARRANTY** One year RTB • **DETAILS** [www.toshiba.co.uk](http://www.toshiba.co.uk) • **PART CODE** PLMOZE-00D003EN • **FULL REVIEW** May 2015





## SMARTPHONES

COMPUTER SHOPPER  
RECOMMENDED

### SAMSUNG Galaxy S6

★★★★★

£480 SIM-free, free on £33.50-per-month contract • [www.carphonewarehouse.com](http://www.carphonewarehouse.com) (SIM-free & contract)

The all-metal Galaxy S6 is one of Samsung's best phones yet. Its performance is among the best we've seen and its 2,560x1,440 screen looks gorgeous. If you want a phone to really turn heads, though, there's also the curvy Galaxy S6 Edge.

PROCESSOR Quad-core 1.5GHz Samsung Exynos 7420 • SCREEN SIZE 5.1in • SCREEN RESOLUTION 2,560x1,440 • REAR CAMERA 16 megapixels • STORAGE 32GB • WIRELESS DATA 4G • SIZE 143x70x6.8mm • WEIGHT 132g • OPERATING SYSTEM Android 5.0 • WARRANTY One year RTB • DETAILS [www.samsung.com/uk](http://www.samsung.com/uk) • PART CODE SM-G920F • FULL REVIEW Jul 2015



COMPUTER SHOPPER  
BEST BUY

### APPLE iPhone 6

★★★★★

£539 SIM-free, free on £36-per-month contract • [store.apple.com/uk](http://store.apple.com/uk) (SIM-free), [www.carphonewarehouse.com](http://www.carphonewarehouse.com) (contract)

It took Apple a while, but it finally increased screen size with the iPhone 6 range. Now with a 4.7in display, a fast processor, improved battery life and iOS 8.3, the iPhone 6 is an improvement in every way on the iPhone 5s.

PROCESSOR Dual-core 1.4GHz Apple A8 • SCREEN SIZE 4.7in • SCREEN RESOLUTION 1,334x750 • REAR CAMERA 8 megapixels • STORAGE 16GB • WIRELESS DATA 4G • SIZE 138x67x6.9mm • WEIGHT 129g • OPERATING SYSTEM iOS 8.3 • WARRANTY One year RTB • DETAILS [www.apple.com/uk](http://www.apple.com/uk) • PART CODE iPhone 6 • FULL REVIEW Dec 2014



COMPUTER SHOPPER  
BEST BUY

### SONY Xperia Z3 Compact

★★★★★

£282 SIM-free, £60 on £17-per-month contract • [www.handtec.co.uk](http://www.handtec.co.uk) (SIM-free), [www.carphonewarehouse.com](http://www.carphonewarehouse.com) (contract)

With its incredible 20-hour battery life and fast performance, the Sony Xperia Z3 Compact brings flagship features to a smaller handset at a great price.

PROCESSOR Quad-core 2.5GHz Qualcomm Snapdragon 801 • SCREEN SIZE 4.6in • SCREEN RESOLUTION 1,280x720 • REAR CAMERA 20.7 megapixels • STORAGE 16GB • WIRELESS DATA 4G • DIMENSIONS 127x65x8.6mm • WEIGHT 129g • OPERATING SYSTEM Android 4.4 • DETAILS [www.sony.co.uk](http://www.sony.co.uk) • PART CODE Sony D5803 • FULL REVIEW Jan 2015



COMPUTER SHOPPER  
BEST BUY

### MICROSOFT Lumia 640

★★★★★

£119 SIM-free, free on £10.50-per-month contract • [www.ebuyer.com](http://www.ebuyer.com) (SIM-free), [www.carphonewarehouse.com](http://www.carphonewarehouse.com) (contract)

The best budget Windows phone around. Its 5in screen is fantastic and its snappy performance punches above its price range. There's also the jumbo Lumia 640 XL if you want more battery life.

PROCESSOR Quad-core 1.2GHz Qualcomm Snapdragon 400 • SCREEN SIZE 5in • SCREEN RESOLUTION 1,280x720 • REAR CAMERA 8 megapixels • STORAGE 8GB • WIRELESS DATA 4G • DIMENSIONS 141x72x8.8mm • WEIGHT 145g • OPERATING SYSTEM Windows Phone 8.1 • DETAILS [www.microsoft.com](http://www.microsoft.com) • PART CODE RM-1072 • FULL REVIEW Aug 2015



COMPUTER SHOPPER  
BEST BUY

### MOTOROLA Moto G (2nd Gen.)

★★★★★

£149 SIM-free, free on £11.50-per-month contract • [www.motorola.co.uk](http://www.motorola.co.uk) (SIM-free), [www.idmobile.co.uk](http://www.idmobile.co.uk) (contract)

The Moto G just got even better. Now available with a larger screen, better camera, longer battery life and 4G, the new Moto G is the best budget smartphone of the year.

PROCESSOR Quad-core 1.2GHz Qualcomm Snapdragon 400 • SCREEN SIZE 5in • SCREEN RESOLUTION 1,280x720 • REAR CAMERA 8 megapixels • STORAGE 8GB • WIRELESS DATA 4G • DIMENSIONS 141x70x11mm • WEIGHT 149g • OPERATING SYSTEM Android 4.4 • DETAILS [www.motorola.co.uk](http://www.motorola.co.uk) • PART CODE XT1068 • FULL REVIEW Jan 2015



## TABLETS

COMPUTER SHOPPER  
RECOMMENDED

### SONY Xperia Z4 Tablet

★★★★★

£500 inc VAT • [www.expansys.com](http://www.expansys.com)

It's expensive, but the Z4 Tablet is a stunning bit of kit. It weighs just 389g, so is lighter than the iPad Air 2, and is an amazing 6.1mm thick. Its super-high-resolution screen has the best colour accuracy we've seen from an LCD panel, it runs Android 5 beautifully and has the best battery life we've ever seen from a tablet.

PROCESSOR Octa-core 2.0GHz Qualcomm Snapdragon 810 • SCREEN SIZE 10.1in • SCREEN RESOLUTION 2,560x1,600 • REAR CAMERA 8.1 megapixels • STORAGE 32GB • WIRELESS DATA 4G (optional) • DIMENSIONS 167x254x6.1mm • WEIGHT 389g • OPERATING SYSTEM Android 5 • WARRANTY One year RTB • DETAILS [www.sonymobile.com](http://www.sonymobile.com) • PART CODE Xperia Z4 Tablet • FULL REVIEW Aug 2015



COMPUTER SHOPPER  
BEST BUY

### GOOGLE Nexus 9

★★★★★

£300 inc VAT • [www.currys.co.uk](http://www.currys.co.uk)

The Nexus 9 is the first Google-branded tablet to have an iPad-style 4:3 ratio screen, which we think is a better shape for web browsing. Android 5.0 Lollipop runs beautifully and its battery life is superb.

PROCESSOR Dual-core 2.3GHz 64-bit Nvidia Tegra K1 Denver • SCREEN SIZE 8.9in • SCREEN RESOLUTION 2,048x1,536 • REAR CAMERA 8 megapixels • STORAGE 16GB • WIRELESS DATA 4G (optional) • DIMENSIONS 154x228x8.8mm • WEIGHT 425g • OPERATING SYSTEM Android 5.0 • WARRANTY One year RTB • DETAILS [www.google.com/nexus/9](http://www.google.com/nexus/9) • FULL REVIEW Aug 2015



COMPUTER SHOPPER  
RECOMMENDED

### APPLE iPad Air 2

★★★★★

£399 inc VAT • [store.apple.com/uk](http://store.apple.com/uk)

The iPad Air 2 is even thinner and lighter than its predecessor and still feels beautifully made. It's the fastest iPad yet, and now has TouchID fingerprint recognition for added security.

PROCESSOR Tri-core 1.5GHz Apple A8X • SCREEN SIZE 9.7in • SCREEN RESOLUTION 2,048x1,536 • REAR CAMERA 8 megapixels • STORAGE 16GB • WIRELESS DATA 4G (optional) • DIMENSIONS 240x170x6.1mm • WEIGHT 437g • OPERATING SYSTEM iOS 8.3 • WARRANTY One year RTB • PART CODE Apple iPad Air 2 • DETAILS [www.apple.com/uk](http://www.apple.com/uk) • FULL REVIEW Aug 2015



COMPUTER SHOPPER  
RECOMMENDED

### MICROSOFT Surface 3

★★★★★

£499 inc VAT • [www.microsoftstore.com](http://www.microsoftstore.com)

If you're after a Windows tablet but the £600-plus Surface Pro 3 is too much for you, the Surface 3 is the model to get. It's beautifully made with a great screen, and if you add the optional Type Cover keyboard you'll have a super-light laptop for working on the move.

PROCESSOR Quad-core 1.6GHz Intel Atom X7-28700 • SCREEN SIZE 10.8in • SCREEN RESOLUTION 1,920x1,280 • REAR CAMERA 8 megapixels • STORAGE 128GB • WIRELESS DATA 4G • DIMENSIONS 187x267x8.7mm • WEIGHT 622g • OPERATING SYSTEM Windows 8.1 (64-bit) • WARRANTY One year RTB • DETAILS [www.microsoft.com](http://www.microsoft.com) • PART CODE Surface 3 • FULL REVIEW Aug 2015



COMPUTER SHOPPER  
BEST BUY

### TESCO Hudl 2

★★★★★

£99 inc VAT • [www.tesco.com/direct/hudl](http://www.tesco.com/direct/hudl)

The Hudl 2 is even better value than the original. It has a great screen, good build quality and runs Android smoothly. Battery life isn't great, but otherwise this is a fantastic complete budget tablet.

PROCESSOR Quad-core 1.33GHz Intel Atom Z3730 • SCREEN SIZE 8.3in • SCREEN RESOLUTION 1,920x1,200 • REAR CAMERA 5 megapixels • STORAGE 16GB • WIRELESS DATA None • DIMENSIONS 228x128x9mm • WEIGHT 410g • OPERATING SYSTEM Android 4.4.2 • WARRANTY One year RTB • PART CODE hudl2 • DETAILS [www.tesco.com/direct/hudl](http://www.tesco.com/direct/hudl) • FULL REVIEW Aug 2015



## Choosing a ...

## Smartphone

**01** A smartphone's operating system (OS) dictates its basic features and which third-party software you can install. There are three main contenders: Apple's iOS, which is found on the iPhone; Google's Android, which is used by various handset manufacturers; and Windows Phone 8, which is becoming more widespread and is a great alternative to Apple's and Google's operating systems. Apple iOS and Google Android have the most apps available but Windows Phone is slowly catching up.

**02** All smartphones have colour screens, but their resolutions vary. Basic models have 800x480 pixels, but text can be indistinct. Look for a display that has at least 1,280x720 pixels so it's easy to browse web pages. Don't worry too much about built-in media players or Office document editors – you can always install apps to replace these with better versions later.

Cameras are improving in smartphones, and resolutions have increased to as high as 20 megapixels. The image quality of smartphone cameras has improved tremendously in recent years.

**03** Barely any modern smartphones have a physical keyboard for entering text: they almost exclusively use touchscreens. Physical keyboards can aid heavy emailing, but touchscreen keyboards work just as well now. Android smartphones and iPhones running iOS 8 let you install a variety of custom onscreen keyboards so you can find one that suits you.

**04** Be careful when choosing a mobile contract. Look for one with a large data allowance if you want to use the internet regularly or you've set your phone to synchronise your contacts, calendar and email through online services such as Google's.

Built-in Wi-Fi can help you avoid high data charges by connecting to the internet through wireless hotspots when you're out, or your router when you're at home. Android and iPhone handsets can operate as wireless hotspots, enabling you to connect your laptop to the web over your mobile data connection. There may be an extra charge for this.

# Choosing a ...

## Digital camera

**01** A basic digital camera will suit someone who wants to take pictures to view on their computer and create 7x5in prints. It should cost around £80, but there may be hidden downsides such as slow performance and very basic user controls.

**02** Spend a little more and you'll get a higher resolution. A 16-megapixel sensor has the potential to produce sharp prints up to A3 size, but only if it and the lens are of a suitably high quality. Very high resolutions in compact cameras tend to boost noise more than detail levels, so many of the best models strike a sensible balance by using a 12-megapixel sensor. Back-illuminated CMOS sensors tend to produce less noise than CCDs, but check our reviews to find out how a particular model performs.

**03** A 3x zoom lens gives you reasonable scope for framing your shots, but a larger range can do wonders for your photography. Most compact cameras can manage a 5x zoom, while pocket-size ultra-zoom cameras can provide 24x zoom ranges. Numbers such as 28-105mm tell you the wide-angle and telephoto limits of the zoom range. Big zooms require optical image stabilisation to avoid blur due to camera shake when zoomed right in.

**04** Most cameras now have a 3in screen. Look out for 460,000-dot or 921,000-dot resolutions for a sharper picture. A touchscreen is useful for moving the autofocus point.

**05** Leave some room in your budget for a memory card, as the bundled memory is never enough. A 16GB card costs less than £10. You may also need to buy batteries.

**06** Don't forget that a camera's specification tells you little about its image quality. You'll need to read our reviews for that. With a compact camera, we believe the user shouldn't have to grapple with complicated controls in order to take great pictures in a range of lighting conditions.

## PHOTOGRAPHY

COMPACT SYSTEM CAMERA	<p><b>COMPUTER SHOPPER</b> <b>SAMSUNG NX3000</b> RECOMMENDED ★★★★★ £229 inc VAT • <a href="http://www.ukdigitalcameras.co.uk">www.ukdigitalcameras.co.uk</a></p> <p>With its high image quality, wealth of features and slim design, the NX3000 is an excellent camera. Better still, at its current low price it's an unbelievable bargain. Buy one while you can.</p> <p>SENSOR RESOLUTION 20 megapixels • SENSOR SIZE 23.5x15.7mm (APS-C) • FOCAL LENGTH MULTIPLIER 1.5x • VIEWFINDER None • LCD SCREEN 3in (460,800 dots) • OPTICAL ZOOM (35mm-EQUIVALENT FOCAL LENGTHS) 3.1x (24-75mm) • 35mm-EQUIVALENT APERTURE f/5.2-8.4 • LENS MOUNT Samsung NX • WEIGHT 386g • DIMENSIONS 67x126x78mm • WARRANTY One year RTB • DETAILS <a href="http://www.samsung.com/uk">www.samsung.com/uk</a> • FULL REVIEW Jan 2015</p> 
COMPACT CAMERA	<p><b>COMPUTER SHOPPER</b> <b>NIKON Coolpix S9700</b> BEST BUY ★★★★★ £150 inc VAT • <a href="http://www.buyacamera.co.uk">www.buyacamera.co.uk</a></p> <p>This compact camera packs in a 30x zoom lens, Wi-Fi, GPS and slow-motion video. Its has a comprehensive set of controls, but it's the image quality that really impresses, achieving decent shots in tough conditions.</p> <p>SENSOR RESOLUTION 16 megapixels • SENSOR SIZE 1/2.3in • VIEWFINDER None • LCD SCREEN 3in (921,000 dots) • OPTICAL ZOOM (35mm-EQUIVALENT FOCAL LENGTHS) 30x (25-750mm) • 35mm-EQUIVALENT APERTURE f/21-36 • WEIGHT 235g • DIMENSIONS 66x110x34mm • WARRANTY Two years RTB • DETAILS <a href="http://www.nikon.co.uk">www.nikon.co.uk</a> • FULL REVIEW Nov 2014</p> 
ULTRA-ZOOM CAMERA	<p><b>COMPUTER SHOPPER</b> <b>PANASONIC Lumix DMC-FZ200</b> BEST BUY ★★★★★ £309 inc VAT • <a href="http://www.johnlewis.com">www.johnlewis.com</a></p> <p>This ultra-zoom camera has a big 25-600mm zoom range and maintains a fast F2.8 aperture across the whole focal range, so you can shoot in low-light conditions without too much worry.</p> <p>SENSOR RESOLUTION 12.1 megapixels • SENSOR SIZE 6.2x4.6mm (1/2.3in) • VIEWFINDER Electronic • LCD SCREEN 3in • OPTICAL ZOOM (35mm-EQUIVALENT FOCAL LENGTHS) 24x (25-600mm) • 35mm-EQUIVALENT APERTURE f/15-5 • WEIGHT 588g • DIMENSIONS 87x125x110mm • WARRANTY One year RTB • DETAILS <a href="http://www.panasonic.com/uk">www.panasonic.com/uk</a> • FULL REVIEW Feb 2013</p> 
SLR CAMERA	<p><b>COMPUTER SHOPPER</b> <b>NIKON D7200</b> BEST BUY ★★★★★ £849 inc VAT (body only) • <a href="http://www.wexphotographic.com">www.wexphotographic.com</a></p> <p>The new Nikon D7200 takes the best photos possible without switching up to a full-frame camera at huge expense. Pair that with superb ergonomics and it's simply unbeatable.</p> <p>SENSOR RESOLUTION 24 megapixels • SENSOR SIZE 23.5x15.6mm (APS-C) • FOCAL LENGTH MULTIPLIER 1.5x • VIEWFINDER optical • LCD SCREEN 3.2in • OPTICAL ZOOM (35mm-EQUIVALENT FOCAL LENGTHS) N/A • 35mm-EQUIVALENT APERTURE N/A • LENS MOUNT F-mount • WEIGHT 765g • DIMENSIONS 107x136x76mm • WARRANTY Two years RTB • DETAILS <a href="http://www.nikon.co.uk">www.nikon.co.uk</a> • FULL REVIEW Aug 2015</p> 
COMPACT CAMERA	<p><b>COMPUTER SHOPPER</b> <b>CANON PowerShot G7 X</b> BEST BUY ★★★★★ £394 inc VAT • <a href="http://www.wexphotographic.com">www.wexphotographic.com</a></p> <p>Near SLR-quality stills in a truly pocketable package, the PowerShot G7 X is a huge step up from most other compact cameras yet the price is great.</p> <p>SENSOR RESOLUTION 20 megapixels • SENSOR SIZE 1in • VIEWFINDER None • LCD SCREEN 3in (1,040,000 dots) • OPTICAL ZOOM (35mm-EQUIVALENT FOCAL LENGTHS) 4.2x (24-100mm) • 35mm-EQUIVALENT APERTURE f/4.9-7.6 • WEIGHT 301g • DIMENSIONS 64x107x40mm • WARRANTY One year RTB • DETAILS <a href="http://www.canon.co.uk">www.canon.co.uk</a> • FULL REVIEW May 2015</p> 

## DISPLAYS

MONITOR	<p><b>COMPUTER SHOPPER</b> <b>BENQ GW2765HT</b> BEST BUY ★★★★★ £275 inc VAT • <a href="http://www.cclonline.com">www.cclonline.com</a></p> <p>This 27in 2,560x1,440 IPS monitor is one of the best-value screens we've ever seen. With near-perfect sRGB colour accuracy out of the box, it's a steal for less than £300.</p> <p>SCREEN SIZE 27in • RESOLUTION 2,560x1,440 • SCREEN TECHNOLOGY IPS • VIDEO INPUTS VGA, DVI, HDMI, DisplayPort • WARRANTY Two years onsite • PART CODE GW2765HT • DETAILS <a href="http://www.benq.co.uk">www.benq.co.uk</a> • FULL REVIEW Jan 2015</p> 
MONITOR	<p><b>COMPUTER SHOPPER</b> <b>VIEWSONIC VX2363Smhl-W</b> RECOMMENDED ★★★★★ £129 inc VAT • <a href="http://www.debenhamsplus.com">www.debenhamsplus.com</a></p> <p>The 23in VX2363Smhl-W stands out from the crowd with its white stand, IPS screen and great overall image quality. It's a good budget buy for those who have modest needs.</p> <p>SCREEN SIZE 23in • RESOLUTION 1,920x1,080 • SCREEN TECHNOLOGY IPS • VIDEO INPUTS VGA, DVI, HDMI, tx MHL-compatible HDMI • WARRANTY Two years collect and return • PART CODE VX2363Smhl-W • DETAILS <a href="http://www.viewsoniceurope.com">www.viewsoniceurope.com</a> • FULL REVIEW Jan 2015</p> 
MONITOR	<p><b>COMPUTER SHOPPER</b> <b>IYYAMA ProLite GB2488HSU-B1</b> BEST BUY ★★★★★ £205 inc VAT • <a href="http://www.cclonline.com">www.cclonline.com</a></p> <p>Gamers need look no further than the Iiyama ProLite GB2488HSU-B1. It's a no-nonsense Full HD panel with a 144Hz refresh rate for lightning-fast games. This display is great value.</p> <p>SCREEN SIZE 24in • RESOLUTION 1,920x1,080 • SCREEN TECHNOLOGY TN • VIDEO INPUTS 2x HDMI, DVI, DisplayPort • WARRANTY Two years onsite • PART CODE ProLite GB2488HSU-B1 • DETAILS <a href="http://www.iiyama.com">www.iiyama.com</a> • FULL REVIEW Aug 2014</p> 
MONITOR	<p><b>COMPUTER SHOPPER</b> <b>ASUS PB279Q</b> BEST BUY ★★★★★ £563 inc VAT • <a href="http://www.balllicom.co.uk">www.balllicom.co.uk</a></p> <p>If you're remotely serious about design, photography or gaming and want an Ultra HD screen, this is the monitor to choose. It's plain to look at and has no USB hub, but in terms of pure image quality, nothing beats it at this price.</p> <p>SCREEN SIZE 27in • RESOLUTION 3,840x2,160 • SCREEN TECHNOLOGY AHVA • REFRESH RATE 60Hz • VIDEO INPUTS 4x HDMI, DisplayPort, Mini DisplayPort • WARRANTY Three years RTB • DETAILS <a href="http://www.asus.com">www.asus.com</a> • FULL REVIEW Apr 2015</p> 
MONITOR	<p><b>COMPUTER SHOPPER</b> <b>SAMSUNG S32D850T</b> BEST BUY ★★★★★ £439 inc VAT • <a href="http://www.laptopsdirect.co.uk">www.laptopsdirect.co.uk</a></p> <p>It's not cheap, but this 32in monitor is great value. Images are sharp and vibrant on its 2,560x1,440 panel, and the stand is among the most attractive we've seen.</p> <p>SCREEN SIZE 32in • RESOLUTION 2,560x1,440 • SCREEN TECHNOLOGY VA • VIDEO INPUTS HDMI, DVI, DisplayPort • WARRANTY Two years collect and return • PART CODE S32D850T • DETAILS <a href="http://www.samsung.com/uk">www.samsung.com/uk</a> • FULL REVIEW Jan 2015</p> 



# Choosing a ...

## Bluetooth speaker

**01** Bluetooth speakers come in all shapes and sizes, so it's worth deciding what you want to do with it before you buy. If you don't plan to take your music outdoors or around the house, look for a wired speaker. These are typically cheaper than speakers with built-in batteries. If you do want a portable speaker, however, pay particular attention to how much it weighs. Ruggedised models should be able to survive accidental drops, water spills and unexpected rain showers.

**02** Many of the cheapest Bluetooth speakers use the lossy A2DP Bluetooth protocol, which is prone to compressing your music and discarding detail compared with the original recording. It's hard to tell the difference when listening to pocket sized speakers, but if you're looking for a speaker to fill a room, an aptX-compatible device is a better option. This Bluetooth protocol retains more detail than A2DP, although you'll need to use it with a compatible smartphone to get the benefits.

**03** As with any audio product, the number and size of speaker drivers can have a significant impact on the quality of sound you get from a Bluetooth speaker. Typically, the presence of multiple drivers enables the manufacturer to tune each one for specific frequencies, directing high-end sounds towards a tweeter and sending the mid-range frequencies to the main driver. Single-driver speakers with larger driver cones can be just as capable of producing fantastic audio, however.

**04** Most Bluetooth speakers have at least one auxiliary input for a wired 3.5mm audio jack, in case you want to listen to music from a device that doesn't have Bluetooth. There are other extra features to look out for, though. Speakers with built-in batteries may have a USB port for charging your smartphone, or a built-in microphone to turn it into a speakerphone when a paired smartphone receives a call. Not all speakers have physical controls – many rely on your paired device's controls for adjusting the volume or muting playback.

### HOME CINEMA

#### COMPUTER SHOPPER LG 47LB730V

BEST BUY ★★★★★

£623 inc VAT • [www.nigelohara.com](http://www.nigelohara.com)

The LG 47LB730V has one of the best screens and smart TV interfaces we've seen. With its fantastic design and great picture quality straight out of the box, the 47LB730V is great value.

SCREEN SIZE 47in • NATIVE RESOLUTION 1,920x1,080 • VIDEO INPUTS 3x HDMI, SCART, component, composite • TUNER Freeview HD • DIMENSIONS 1,061x666x227mm • WARRANTY Five years RTB • DETAILS [www.lg.com/uk](http://www.lg.com/uk) • PART CODE 47LB730V • FULL REVIEW Mar 2015



#### COMPUTER SHOPPER FINLUX 48FT3E242S-T

RECOMMENDED ★★★★★

£400 inc VAT • [finlux.co.uk](http://finlux.co.uk)

If you're after an ultra-cheap second TV, this might be right up your street. It lacks a few catch-up and on-demand services, so you might need to extend this with a cheap set-top box. For a 48in TV, it's a cracking bargain.

SCREEN SIZE 48in • NATIVE RESOLUTION 1,920x1,080 • VIDEO INPUTS 3x HDMI, SCART, VGA composite • TUNER Freeview HD • DIMENSIONS 1,084x220x720mm • WARRANTY One year RTB • DETAILS [www.finlux.co.uk](http://www.finlux.co.uk) • PART CODE 48FT3E242S-T • FULL REVIEW Jul 2015



#### COMPUTER SHOPPER ONKYO TX-NR636

BEST BUY ★★★★★

£349 inc VAT • [www.richersounds.com](http://www.richersounds.com)

With multiple HDMI 2.0 ports for 4K content and Dolby Atmos Home support, the Onkyo TX-NR636 is an essential AV receiver if you're looking to futureproof your home cinema system.

HDMI INPUTS/OUTPUTS 7/2 • HDMI 2.0 INPUTS/OUTPUTS 5/1 • OUTPUT RESOLUTIONS 720p, 1080p, 4K • WIRELESS SUPPORT 802.11n, Bluetooth 2.1 • SPEAKER CONFIGURATION 7.2 • RMS POWER OUTPUT 1,200W • SIZE 435x173x329mm • WARRANTY Two years RTB • DETAILS [www.eu.onkyo.com](http://www.eu.onkyo.com) • PART CODE TX-NR636 • FULL REVIEW Jun 2015



#### COMPUTER SHOPPER SAMSUNG BD-H6500

BEST BUY ★★★★★

£130 inc VAT • [www.argos.co.uk](http://www.argos.co.uk)

This 3D-capable Blu-ray player produces a great picture, offers an excellent range of Smart TV services and provides the best DVD upscaling we've seen at this price.

BLU-RAY PROFILE BD-Live (Profile 5) • HDMI VERSION 1.4 • 3D CAPABLE Yes • NETWORKING 1x 10/100, 802.11n • WARRANTY One year RTB • PART CODE BD-H6500 • DETAILS [www.samsung.com/uk](http://www.samsung.com/uk) • FULL REVIEW Oct 2014



#### COMPUTER SHOPPER SAMSUNG HW-J7500

RECOMMENDED ★★★★★

£650 inc VAT • [www.johnlewis.com](http://www.johnlewis.com)

This curved 8.1 soundbar and wireless subwoofer not only looks great, but it also produces excellent sound and has plenty of ports.

SPEAKERS 8 • RMS POWER OUTPUT 320W • DIMENSIONS 1,230x170x42mm (soundbar), 291x371x291mm (subwoofer) • WEIGHT 4kg (soundbar), 7.8kg (subwoofer) • DOCK CONNECTOR None • NETWORKING Bluetooth 3.0 • WARRANTY One year RTB • DETAILS [www.samsung.com/uk](http://www.samsung.com/uk) • PART CODE HW-J7500 • FULL REVIEW Jul 2015



### AUDIO

#### COMPUTER SHOPPER PHILIPS Fidelio M2BT

BEST BUY ★★★★★

£220 inc VAT • [www.amazon.co.uk](http://www.amazon.co.uk)

The Philips Fidelio M2BT are premium Bluetooth headphones that sound great, look fantastic and are supremely comfortable.

HEADPHONES TYPE On-ear Bluetooth • PLUG TYPE 3.5mm jack plug • WEIGHT 190g • CABLE LENGTH 1.2m • WARRANTY One year RTB • DETAILS [www.philips.co.uk](http://www.philips.co.uk) • PART CODE M2BTBK/00 • FULL REVIEW Apr 2015



#### COMPUTER SHOPPER BLUESOUND Pulse

RECOMMENDED ★★★★★

£599 inc VAT • [www.sevenoakssoundandvision.co.uk](http://www.sevenoakssoundandvision.co.uk)

The audiophile's choice for multiroom audio. The Bluesound Pulse has excellent sound quality, support for high-resolution audio and is compatible with plenty of music-streaming services.

SPEAKERS 5 • RMS POWER OUTPUT 80W • DOCK CONNECTOR None • WIRELESS 802.11n Wi-Fi, 10/100 Ethernet, optional Bluetooth (SBC) • DIMENSIONS 420x190x197mm • WEIGHT 6.1kg • WARRANTY One year RTB • DETAILS [www.bluesound.com](http://www.bluesound.com) • FULL REVIEW Mar 2015



#### COMPUTER SHOPPER RAZER Leviathan

RECOMMENDED ★★★★★

£150 inc VAT • [www.box.co.uk](http://www.box.co.uk)

Soundbars are usually built for TVs, but Razer's Leviathan is ideal for sliding underneath a computer monitor. It sounds great and is more than loud enough to fill a room.

SPEAKERS 4 • RMS POWER OUTPUT 30W • WEIGHT 2kg (bar), 2.3kg (subwoofer) • NETWORKING Bluetooth (SBC, aptX) • WARRANTY Two years RTB • DETAILS [www.razerzone.com](http://www.razerzone.com) • PART CODE RZ05-01260100-R3G1 • FULL REVIEW Jul 2015



#### COMPUTER SHOPPER ULTIMATE EARS UE Megaboom

RECOMMENDED ★★★★★

£250 inc VAT • [www.currys.co.uk](http://www.currys.co.uk)

The UE Megaboom is an intensely loud and powerful Bluetooth speaker that provides a warm and impactful sound. It's waterproof, too, so could provide some entertainment poolside or at your next barbecue.

SPEAKERS 4 • RMS POWER OUTPUT Not disclosed • DOCK CONNECTOR None • WIRELESS Bluetooth (SBC) • DIMENSIONS 83x83x226mm • WEIGHT 877g • WARRANTY Two year RTB • DETAILS [www.ultimateears.com](http://www.ultimateears.com) • PART CODE UE Megaboom • FULL REVIEW Aug 2015



#### COMPUTER SHOPPER ARCAM miniBlink

RECOMMENDED ★★★★★

£100 inc VAT • [www.petertyson.co.uk](http://www.petertyson.co.uk)

Stream music from your mobile phone or tablet to your hi-fi with the petite and attractive miniBlink. This high-quality Bluetooth receiver sounds good and is delightfully simple to use.

WARRANTY Two years RTB • PART CODE miniBlink • DETAILS [www.arcam.co.uk](http://www.arcam.co.uk) • FULL REVIEW Aug 2014



SMART TV

SMART TV

AV RECEIVER

BLU-RAY PLAYER

SOUNDBAR/SUBWOOFER

ON-EAR HEADPHONES

PORTABLE SPEAKER

PC GAMING SOUNDBAR

BLUETOOTH SPEAKER

AUDIO INTERFACE

# Choosing a...

## NAS device

**01** A network-attached storage (NAS) device lets you store media, documents and other files on its hard disks so that you can share them with others on your network. Some have disks already installed, while others are empty enclosures into which you install your own disks.

You should buy one with a Gigabit Ethernet interface, as these provide the highest transfer speeds. To use a NAS device at these speeds, you'll need computers with Gigabit Ethernet network adaptors and a Gigabit Ethernet switch or router. Computers with Fast Ethernet adaptors can still access the NAS device, but only at 100Mbit/s.

**02** The amount of network storage you need depends on the types of files you use. If you want to store Word and Excel documents, for example, a 1TB device will be more than enough. In fact, a 1TB device should be sufficient for a family's entire media collection. Small businesses should consider higher storage capacities, depending on the nature of the business.

**03** If you can see no end to your storage needs, buy an upgradable NAS device. Many have a USB port for adding an external disk. Devices such as Synology's barebones NAS kits have spare disk trays for cheaper and faster upgrades.

**04** If you want extra protection for your data, look for a device that supports RAID. RAID 1 and RAID 5 arrays reduce the available capacity by duplicating data, but you won't lose that data if a disk fails.

**05** If you need access to your files while you're away from home or the office, look for a NAS device with an FTP server. Some can also share a USB printer across your network, saving you the expense of buying an Ethernet printer. A NAS device with a Universal Plug and Play (UPnP) media server can stream your music, photos and videos to a network media player, so you can enjoy your media collection in another room.

## STORAGE



### CRUCIAL MX100 256GB

★★★★★

SSD

£92 inc VAT • [www.ebuyer.com](http://www.ebuyer.com)

The MX100 is quick for a budget SSD and the price makes the 256GB model fantastic value. 128GB and 512GB models are also available if you want to save money, or need more storage

CAPACITY 256GB • COST PER GIGABYTE £0.36 • INTERFACE SATA3 • WARRANTY Three years RTB • PART CODE CT256MX100SSD1 • DETAILS [uk.crucial.com](http://uk.crucial.com) • FULL REVIEW Apr 2015



### WESTERN DIGITAL Red 6TB

★★★★★

HARD DISK

£193 inc VAT • [www.cclonline.com](http://www.cclonline.com)

The Red 6TB combines excellent performance with a high capacity and special firmware, making a hard disk that's perfect for use in NAS enclosures.

CAPACITY 6TB • COST PER GIGABYTE £0.03 • INTERFACE SATA3 • WARRANTY Three years RTB • PART CODE WD60EFRX • DETAILS [www.wdc.com](http://www.wdc.com) • FULL REVIEW Nov 2014



### SYNOLOGY Diskstation DS215j

★★★★★

NAS

£135 inc VAT • [www.dabs.com](http://www.dabs.com)

Synology's latest NAS is faster than its predecessor thanks to an upgraded CPU, and is capable of rapid file transfers. DSM is still the best NAS operating system we've used, too.

3 1/2in HARD DISK BAYS (FREE) 2 (2) • NETWORKING 2x 10/100/1000 Ethernet • WARRANTY Two years RTB • PART CODE DS215J • DETAILS [www.synology.com](http://www.synology.com) • FULL REVIEW Jun 2015



### SAMSUNG T1 500GB

★★★★★

PORTABLE SSD

£178 inc VAT • [www.ebuyer.com](http://www.ebuyer.com)

The T1 is significantly faster than any USB3 flash drive as it has its own SSD controller. Combined with a USB3 connection, it's able to transfer files at unbelievable speeds – then slips into a pocket for taking on the move.

CAPACITY 500GB • COST PER GIGABYTE £0.36 • INTERFACE USB3 • CLAIMED READ 450MB/s • CLAIMED WRITE 450MB/s • WARRANTY Three years RTB • PART CODE MU-PS500B/EU • DETAILS [www.samsung.com/uk](http://www.samsung.com/uk) • FULL REVIEW Apr 2015



### WESTERN DIGITAL My Passport Ultra 1TB

★★★★★

PORTABLE HARD DISK

£49 inc VAT • [www.pcworld.co.uk](http://www.pcworld.co.uk)

This compact 5400rpm USB3 external hard disk comes with excellent backup and encryption software. We reviewed the 1TB model, which is a bargain, but for an extra £25 you can pick up the 2TB version.

CAPACITY 1TB • COST PER GIGABYTE £0.05 • SPINDLE SPEED 5,400rpm • INTERFACES USB3 • DIMENSIONS 15x82x11mm • WARRANTY Three years RTB • PART CODE WDBZFP0010BBK • DETAILS [www.wdc.com](http://www.wdc.com) • FULL REVIEW Sep 2013



## PRINTERS AND SCANNERS



### XEROX Phaser 3610

★★★★★

MONO LASER PRINTER

£258 inc VAT • [www.amazon.co.uk](http://www.amazon.co.uk)

The Phaser 3610 is a mono laser printer for small firms and workgroups. It's fast, reaching 47ppm in our tests, and has a claimed monthly duty cycle of up to 110,000 pages. Best of all, at 1.1p per page it's cheap to run.

TECHNOLOGY Mono laser • MAXIMUM PRINT RESOLUTION 1,200x1,200dpi • DIMENSIONS 315x393x426mm • WEIGHT 13kg • MAXIMUM PAPER SIZE A4/legal • WARRANTY One year onsite • PART CODE 3610V\_DN • DETAILS [www.xerox.co.uk](http://www.xerox.co.uk) • FULL REVIEW Jan 2014



### CANON i-SENSYS LBP7780Cx

★★★★★

COLOUR LASER

£417 inc VAT • [www.printerland.co.uk](http://www.printerland.co.uk)

It's somewhat expensive to buy, but the Canon i-SENSYS LBP7780Cx is very cheap to run and produces impressively high-quality prints.

TECHNOLOGY Single-pass colour laser • MAXIMUM PRINT RESOLUTION 600x600dpi • DIMENSIONS 401x517x530mm • WEIGHT 31kg • MAXIMUM PAPER SIZE A4/legal • WARRANTY One year onsite • DETAILS [www.canon.co.uk](http://www.canon.co.uk) • PART CODE 6140B010AA • FULL REVIEW Mar 2015



### EPSON Expression Photo XP-760

★★★★★

INK JET MFP

£126 inc VAT • [www.morecomputers.com](http://www.morecomputers.com)

It's not brilliant for printing office documents, but if you want great photos and brilliant scanning, Epson's good-looking and compact XP-760 is perfect.

TECHNOLOGY Piezo inkjet • MAXIMUM PRINT RESOLUTION 5,760x1,440dpi • MAXIMUM OPTICAL SCAN RESOLUTION (OUTPUT BIT DEPTH) 2,400x4,800dpi (48-bit) • DIMENSIONS 141x390x341mm • WEIGHT 6.9kg • MAXIMUM PAPER SIZE A4/legal • WARRANTY One year RTB • DETAILS [www.epson.co.uk](http://www.epson.co.uk) • PART CODE C11CD96401 • FULL REVIEW Mar 2015



### CANON Pixma MG6650

★★★★★

INK JET MFP

£78 inc VAT • [www.amazon.co.uk](http://www.amazon.co.uk)

This well-specified MFP isn't the fastest, but its print, copy and scan quality are superb. Improved touchscreen controls make it easier to use than some Pixmas, and its ink costs are reasonable too.

TECHNOLOGY Thermal inkjet • MAXIMUM PRINT RESOLUTION 4,800x1,200dpi • SCANNER RESOLUTION 1,200x1,200dpi • DIMENSIONS 148x455x369mm • WEIGHT 6.4kg • MAXIMUM PAPER SIZE A4/legal • WARRANTY One year RTB • DETAILS [www.canon.co.uk](http://www.canon.co.uk) • PART CODE 9539B008AA • FULL REVIEW Aug 2015



### HP Officejet Pro X476dw

★★★★★

OFFICE PRINTER

£332 inc VAT • [www.ebuyer.com](http://www.ebuyer.com)

It may be an inkjet, but HP's MFP beats many colour lasers in terms of speed, print quality and running costs.

TECHNOLOGY Thermal inkjet • MAXIMUM PRINT RESOLUTION 2,400x1,200dpi • SCANNER RESOLUTION 1,200x1,200dpi • DIMENSIONS 517x517x399mm • WEIGHT 24kg • MAXIMUM PAPER SIZE A4/legal • WARRANTY One year onsite • DETAILS [www.hp.co.uk](http://www.hp.co.uk) • PART CODE CN461A • FULL REVIEW Mar 2015





## NETWORKS

### COMPUTER SHOPPER BEST BUY TP-LINK Archer C9

£103 inc VAT • [www.argos.co.uk](http://www.argos.co.uk)

It doesn't have a modem, so you'll need to pair it with your ISP's cable, ADSL or fibre modem, but the Archer C9 is an incredibly capable router with plenty of features and fantastic wireless performance.

WI-FI STANDARD 802.11ac • STATED SPEED 1,900Mbit/s • USB PORTS 1x USB3, 1x USB • LAN PORTS 4x Gigabit • WALL MOUNTABLE No • WARRANTY Three years RTB • PART CODE Archer C9 • DETAILS [uk.tp-link.com](http://uk.tp-link.com) • FULL REVIEW Sep 2015



### COMPUTER SHOPPER RECOMMENDED BT Dual-Band Wi-Fi Extender 1200

£50 inc VAT • [www.shop.bt.com](http://www.shop.bt.com)

This fast wireless extender is easy to set up and is the perfect companion to an 802.11ac router. The wired LAN port lets you connect a wired device to your wireless network, too.

WI-FI STANDARD 802.11ac • STATED SPEED 867Mbit/s • LAN PORTS 1x 10/100 • WARRANTY Three years RTB • PART CODE 80462 • DETAILS [connectedhome.bt.com](http://connectedhome.bt.com) • FULL REVIEW Aug 2015



### COMPUTER SHOPPER RECOMMENDED DEVOLO dLAN 1200+ Starter Kit

£110 inc VAT • [www.dabs.com](http://www.dabs.com)

Devolos dLAN 1200+ is the fastest Powerline networking kit we've seen, even if you're limited to a single Gigabit Ethernet connection. The passthrough sockets are very convenient, too.

POWERLINE NETWORKING STANDARD HomePlug • STATED SPEED 1,200Mbit/s • ADAPTORS IN BOX 2 • WARRANTY Three years RTB • PART CODE 09378 • DETAILS [www.devolo.com/uk](http://www.devolo.com/uk) • FULL REVIEW Feb 2015



### COMPUTER SHOPPER RECOMMENDED ASUS EA-AC87

£116 inc VAT • [www.cdonline.com](http://www.cdonline.com)

It's much larger than the average range extender, but that's only to make room for a whopping five Gigabit Ethernet ports. The EA-AC87 can also act as an access point, replacing your router.

MODEM N/A • WI-FI STANDARD 802.11ac • STATED SPEED 1,734Mbit/s • USB PORTS 0 • WALL MOUNTABLE Yes • LAN PORTS 5x Gigabit • WARRANTY Two years RTB • PART CODE 90IG01AQ-BU9000 • DETAILS [www.asus.com](http://www.asus.com) • FULL REVIEW Sep 2015



### D-LINK DSL-3590L

★★★★★

£151 inc VAT • [www.dabs.com](http://www.dabs.com)

If you want to ditch your ISP-provided modem router, D-Link's DSL-3590L should be your first choice. It might not have the fastest Wi-Fi speeds but the feature list is impeccable.

MODEM ADSL2+ • WI-FI STANDARD 802.11ac • STATED SPEED 1,900Mbit/s • USB PORTS 1x USB3, 1x USB • LAN PORTS 4x Gigabit • WALL MOUNTABLE No • WARRANTY Two years RTB • PART CODE DSL-3590 • DETAILS [www.dlink.com](http://www.dlink.com) • FULL REVIEW Sep 2015



## VIDEO

### COMPUTER SHOPPER RECOMMENDED AMAZON Fire TV Stick

£35 inc VAT • [www.amazon.co.uk](http://www.amazon.co.uk)

The Amazon Fire TV Stick is a great inexpensive media-streaming device, which excels if you're an Amazon Prime subscriber. Even if you're not, you'll still get good mileage out of the Fire TV Stick through other platforms such as Plex. It's our new favourite discrete streaming device.

VIDEO OUTPUTS HDMI 1.4 • NETWORKING 802.11n • STREAMING FORMATS UPnP, AirPlay, DLNA • INTERNET STREAMING SERVICES iPlayer, Netflix, Sky News, Spotify, TuneIn Radio, Amazon Instant Video, TVPlayer • DIMENSIONS 115x15x17mm • WARRANTY One year RTB • PART CODE Fire TV Stick • DETAILS [www.amazon.co.uk](http://www.amazon.co.uk) • FULL REVIEW Aug 2015



### COMPUTER SHOPPER RECOMMENDED GOPRO Hero4 Black

£300 inc VAT • [www.amazon.co.uk](http://www.amazon.co.uk)

The GoPro Hero4 Black doesn't deviate from the existing GoPro template but is an excellent action camera that introduces stunning 4K video at 30fps. You also get support for a wide range of mounts and accessories, meaning you'll be able to capture fantastic footage whatever the activity.

SENSOR 1/2.3in CMOS • SENSOR PIXELS 12,000,000 • MAX RECORDING RESOLUTION 4K (30fps) • AV CONNECTIONS Micro HDMI output, 3.5mm microphone to Mini USB (optional) • DIMENSIONS 41x59x30mm • WEIGHT 89g (52g with housing) • WARRANTY One year RTB • PART CODE CHDHX-4-1-EU • DETAILS [www.gopro.com](http://www.gopro.com) • FULL REVIEW May 2015



### COMPUTER SHOPPER BEST BUY CANON Legria HF G30

£943 inc VAT • [www.nigelohara.com](http://www.nigelohara.com)

This fantastic enthusiast camcorder has a capacitive touchscreen monitor, a great electronic viewfinder and a sensible array of function buttons. Its image quality is excellent, too.

OPTICAL ZOOM 20x • SENSOR 1/2.3in CMOS • LCD SCREEN 3.7in LCD, 1,230,000 dots • DIMENSIONS 84x189x182mm • WEIGHT 900g • WARRANTY One year RTB • PART CODE 8454B009AA • DETAILS [www.canon.co.uk](http://www.canon.co.uk) • FULL REVIEW Sep 2015



### COMPUTER SHOPPER RECOMMENDED HAUPPAUGE HD PVR Rocket

£112 inc VAT • [www.ebuyer.com](http://www.ebuyer.com)

The HD PVR Rocket lets you record your gameplay from a PC or games console, including your own commentary. It's well designed, with a large red Record button and the ability to record directly to a USB drive.

WARRANTY Two years RTB • PART CODE 1527 • DETAILS [www.hauppage.co.uk](http://www.hauppage.co.uk) • FULL REVIEW Apr 2013



### COMPUTER SHOPPER RECOMMENDED PANASONIC HC-WX970

£749 inc VAT • [www.jessops.com](http://www.jessops.com)

The Panasonic HC-WX970 is a twin-camera 4K-capable camcorder that lets you easily capture 8-megapixel stills from your 4K video. It has fantastic image stabilisation and its HDR video mode can help with exposing difficult scenes.

OPTICAL ZOOM 20x • SENSOR 1/2.3in BSI MOS • LCD SCREEN 3in, 460,800 dots • SIZE (HXWXD) 73x65x139mm • WEIGHT 360g • WARRANTY One year RTB • DETAILS [www.panasonic.com](http://www.panasonic.com) • PART CODE HC-WX970 • FULL REVIEW Sep 2015



## Choosing an ...

## Action camera

**01** Action cameras are typically much smaller than a regular camcorder, as they are designed to be mounted to a bike, board or car, or worn on your person. As the name suggests, they are designed primarily for shooting action footage, but because of their small size they're ideal for strapping on to your pet's collar or your children's toys for a different perspective.

**02** Almost all action cameras will shoot Full HD video, and some will even shoot 4K, but frame rate is arguably more important than resolution when it comes to action video. Higher frame rates will mean smoother clips, and super-high frame rate videos can be played in slow motion to emphasise exciting shots. Keep an eye out for 4k/30p, 1080p/60 and 720p/120 models for the widest possible choice of resolutions and frame rates.

**03** Most action cameras rely on flash memory for storing your video, letting you swap out memory cards on the fly when you fill one up with clips. More expensive devices can have integrated flash memory as well as a card slot, but it's typically cheaper to buy the basic version of a camera and pick up memory cards separately.

**04** Not all action cameras have LCD displays; in fact, many deliberately don't include a screen in order to extend battery life. If you want to see exactly what you're pointing the lens at, keep an eye out for cameras with smartphone companion apps, or wrist-mounted viewfinders that also let you start and stop shooting remotely.

**05** Action cameras typically have a huge range of accessories, with specific mounts and harnesses for different activities and sports. If the camera itself isn't water resistant, a weatherproof case will protect it from the elements, while a tripod mount will let you lock it firmly in place. Spare batteries are essential for longer shoots, and some decent video-editing software will help you to produce a more polished result.

# Choosing an ...

## Intel motherboard

**01** It's essential that you buy the right type of motherboard for your processor. Intel's older 'Ivy Bridge' processors require a motherboard with an LGA1155 socket, but newer, fourth-generation 'Haswell' chips require an LGA1150 socket. A board for an Ivy Bridge processor must also have an H77 or a Z77 chipset, while Haswell processors require the new Z87 chipset.

**02** All current Intel processors have built-in graphics chipsets, so if you want to use your chip's built-in graphics, make sure the motherboard has the video outputs you need, such as VGA, DVI, HDMI and DisplayPort. If you want to play modern games, you'll need to fit a dedicated graphics card in the motherboard's PCI Express x16 slot, although this may block one of your other slots.

**03** Normal tower cases can accommodate ATX motherboards, which provide the most expansion slots. A microATX motherboard will let you build your PC in a smaller case, but if you opt for a microATX board, make sure it has all the features you need built in as there won't be much room for expansion cards.

**04** If you want to install lots of expansion cards, look for a motherboard that offers plenty of PCI and PCI-E x1 slots. Some motherboards also have PCI Express x4 slots and extra PCI Express x16 slots. PCI Express x1 and x4 cards also work in PCI Express x16 slots.



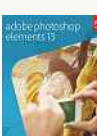


If you need a lot of storage, a motherboard with plenty of SATA2 and SATA3 ports is essential. SATA2 is fine for optical drives and hard disks, but to make the most of an SSD you need SATA3.

**05** All motherboards have built-in audio chipsets, but some support only 5.1 surround sound rather than 7.1. If you're connecting to older surround-sound amplifiers that don't have HDMI, look for an optical or coaxial S/PDIF output. All motherboards have Ethernet ports and most have the faster Gigabit version. You may also find it useful to buy a board with built-in Wi-Fi so you don't have to use up a USB port or PCI slot with an adaptor.

### COMPONENTS

GRAPHICS CARD	<b>COMPUTER SHOPPER</b> <b>RECOMMENDED</b>	<b>MSI GTX 960 Gaming 2G</b> <b>★★★★★</b> <b>£168 inc VAT • www.scan.co.uk</b> Nvidia's latest mid-range card is a fantastic performer at 1080p and will also play most titles at 1440p. It's whisper quiet too, switching its fans off completely when you aren't gaming. <b>GPU</b> Nvidia GeForce GTX 960 • <b>MEMORY</b> 2GB GDDR5 • <b>GRAPHICS CARD LENGTH</b> 367mm • <b>WARRANTY</b> Three years RTB • <b>DETAILS</b> www.msi.com • <b>PART CODE</b> GTX 960 GAMING 2G • <b>FULL REVIEW</b> May 2015	
	<b>COMPUTER SHOPPER</b> <b>BEST BUY</b>	<b>INTEL Core i5-4690K</b> <b>★★★★★</b> <b>£168 inc VAT • www.ebuyer.com</b> The Core i5-4690K is a redesigned variant of the Core i5-4670K and runs at a faster speed out of the box but at lower temperatures. Coupled with its unlocked multiplier, this means the chip is ideal for overclocking. <b>SOCKET</b> LGA1150 • <b>CORES</b> 4 • <b>FREQUENCY</b> 3.5GHz • <b>INTEGRATED GRAPHICS</b> Intel HD Graphics 4600 • <b>WARRANTY</b> One year RTB • <b>DETAILS</b> www.intel.com • <b>PART CODE</b> BX80646I54690K • <b>FULL REVIEW</b> May 2015	
PROCESSOR	<b>COMPUTER SHOPPER</b> <b>BEST BUY</b>	<b>AMD A10-7700K</b> <b>★★★★★</b> <b>£87 inc VAT • www.scan.co.uk</b> The A10-7700K strikes an excellent balance between desktop and graphics performance, making it the ideal all-rounder for an inexpensive PC build. <b>SOCKET</b> FM2 • <b>CORES</b> 4 • <b>FREQUENCY</b> 3.4GHz • <b>INTEGRATED GRAPHICS</b> AMD Radeon R7 • <b>WARRANTY</b> One year RTB • <b>DETAILS</b> www.amd.com • <b>PART CODE</b> AD770KXBJABOX • <b>FULL REVIEW</b> May 2015	
PROCESSOR	<b>COMPUTER SHOPPER</b> <b>RECOMMENDED</b>	<b>ASUS Z97-E</b> <b>★★★★★</b> <b>£99 inc VAT • www.dabs.com</b> The Asus Z97-E is well priced for an LGA1150 motherboard, and automatic overclocking helps squeeze extra performance from your CPU with minimal effort. <b>SOCKET</b> LGA1150 • <b>CHIPSET</b> Intel Z97 • <b>MEMORY SLOTS</b> 4 • <b>PCI-E x16 SLOTS</b> 2 • <b>PCI-E x1 SLOTS</b> 3 • <b>PCI SLOTS</b> 2 • <b>USB PORTS</b> 2x USB3, 4x USB2 • <b>VIDEO OUTPUTS</b> HDMI, DVI, VGA • <b>DIMENSIONS</b> 305x218mm • <b>WARRANTY</b> Three years RTB • <b>DETAILS</b> www.asus.com • <b>PART CODE</b> Z97-E • <b>FULL REVIEW</b> May 2015	
MOTHERBOARD	<b>COMPUTER SHOPPER</b> <b>RECOMMENDED</b>	<b>SILVERSTONE Quiet Precision PS11</b> <b>★★★★★</b> <b>£37 inc VAT • www.scan.co.uk</b> Well made and finished for the price, with plenty of sound-deadening features, the PS11 is the ideal starting point for a new PC build. The design might be a little plain, but we aren't complaining for £35. <b>CASE TYPE</b> ATX • <b>MOTHERBOARD COMPATIBILITY</b> ATX, microATX, Mini-ITX • <b>SUPPLIED FANS</b> 1x 120mm • <b>MAX 3 1/2in DRIVE BAYS</b> 3 • <b>MAX 5 1/2in DRIVE BAYS</b> 2 • <b>DIMENSIONS</b> 215x482x427mm • <b>WEIGHT</b> 4.8kg • <b>WARRANTY</b> One year RTB • <b>DETAILS</b> www.silverstonetek.com • <b>PART CODE</b> SST-PS11B-Q • <b>FULL REVIEW</b> May 2015	
PC CASE			

### SOFTWARE

VIDEO EDITING	<b>COMPUTER SHOPPER</b> <b>BEST BUY</b>	<b>ADOBE Premiere Elements 13</b> <b>★★★★★</b> <b>£60 inc VAT • www.johnlewis.com</b> Premiere Elements 13 offers a wealth of features to keep advanced video editors happy and has even more to help new users make the most of it. It's the best consumer video-editing package you can buy. <b>OS SUPPORT</b> Windows 7, 8 • <b>MINIMUM CPU</b> 2GHz with SSE2 • <b>MINIMUM GPU</b> DirectX 9 or 10 • <b>MINIMUM RAM</b> 2GB • <b>HARD DISK SPACE</b> 5GB • <b>DETAILS</b> www.adobe.com/uk • <b>PRODUCT CODE</b> 65234288 • <b>FULL REVIEW</b> Jan 2015	
	<b>COMPUTER SHOPPER</b> <b>BEST BUY</b>	<b>SERIF PagePlus X8</b> <b>★★★★★</b> <b>£90 inc VAT • www.serif.com</b> Get full control over the layout and appearance of your documents, from flyers to professional-looking publications. Version 8 adds a baseline grid, making text easier to line up, and improves photo editing. <b>OS SUPPORT</b> Windows XP or later • <b>MINIMUM CPU</b> Intel Pentium 4 or later, AMD Athlon 64 or later • <b>MINIMUM GPU</b> Not stated • <b>MINIMUM RAM</b> 512MB (Windows XP), 1GB (Vista, 32-bit Windows 7/8), 2GB (64-bit Windows 7/8) • <b>HARD DISK SPACE</b> 510MB • <b>DETAILS</b> www.serif.com/pageplus • <b>PRODUCT CODE</b> N/A • <b>FULL REVIEW</b> Feb 2015	
DESKTOP PUBLISHING	<b>COMPUTER SHOPPER</b> <b>RECOMMENDED</b>	<b>ADOBE Photoshop Elements 13</b> <b>★★★★★</b> <b>£60 inc VAT • www.johnlewis.com</b> Elements may not have all the features of the full version of Photoshop, but it's still our favourite photo-editing package, and version 13 is the best yet, thanks to a new Guided mode for newcomers. <b>OS SUPPORT</b> Windows 7, 8 • <b>MINIMUM CPU</b> 1.6GHz with SSE2 • <b>MINIMUM GPU</b> DirectX 9 or 10 • <b>MINIMUM RAM</b> 2GB • <b>HARD DISK SPACE</b> 5GB • <b>DETAILS</b> www.adobe.com/uk • <b>PRODUCT CODE</b> 65237742 • <b>FULL REVIEW</b> Feb 2015	
PHOTO EDITING	<b>COMPUTER SHOPPER</b> <b>BEST BUY</b>	<b>SERIF Affinity Designer</b> <b>★★★★★</b> <b>£30 inc VAT • affinity.serif.com/en-gb</b> The first real competition to Adobe's Illustrator may be an OS X exclusive, but Affinity Designer is a seriously powerful graphic design tool that costs an incredibly reasonable £40. <b>OS SUPPORT</b> Apple OS X 10.7.5 • <b>MINIMUM CPU</b> Core 2 Duo (64-bit) • <b>MINIMUM GPU</b> Intel HD Graphics • <b>MINIMUM RAM</b> 1GB • <b>HARD DISK SPACE</b> 525MB • <b>DETAILS</b> affinity.serif.com • <b>PRODUCT CODE</b> Affinity Designer • <b>FULL REVIEW</b> Mar 2015	
GRAPHIC DESIGN	<b>COMPUTER SHOPPER</b> <b>BEST BUY</b>	<b>STEINBERG Cubase Artist 8</b> <b>★★★★★</b> <b>£220 inc VAT • www.steinberg.net</b> Music production software usually saves the best features for the priciest version, but that's not the case here, making Cubase Artist 8 an excellent investment for musicians aspiring to the highest standards. <b>OS SUPPORT</b> Windows 7 or later • <b>MINIMUM CPU</b> Intel Core/AMD dual-core • <b>MINIMUM GPU</b> DirectX 10 • <b>MINIMUM RAM</b> 4GB • <b>HARD DISK SPACE</b> 15GB • <b>DETAILS</b> www.steinberg.net • <b>PRODUCT CODE</b> 45550 • <b>FULL REVIEW</b> May 2015	
MUSIC PRODUCTION			





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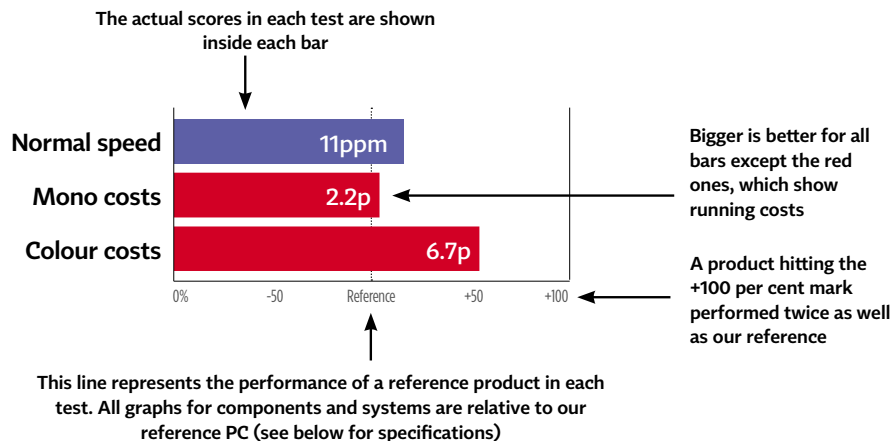


# How we test

Find out how well products perform with the help of *Computer Shopper's* comprehensive tests

**COMPUTER SHOPPER'S REVIEWS** use some of the most exhaustive testing procedures you'll find in any PC magazine. Every product is subjected to qualitative and quantitative tests that show how it performs in practical use. Graphs for performance, battery-life scores and costs are used in the Reviews section, as shown on the right. Look in the 'Summary of tests' box (below) for details of each test we run.

For PCs and laptops, we evaluate performance using our own custom benchmarking suite. See below for a brief description of our benchmarking software and game tests.



## SUMMARY OF TESTS

### PC SYSTEMS

Windows overall	Average speed across numerous demanding tasks
Multitasking	Speed when running simultaneous applications

Dirt Showdown (1080p)	Frames per second at 1,920x1,080, 4xAA, Ultra detail
Metro: Last Light Redux	Frames per second at 1,920x1,080, SSAA, Very High detail

### LAPTOPS

Windows overall	Average speed across numerous demanding tasks
Multitasking	Processor-intensive multitasking test
Dirt Showdown (720p)	Frames per second at 1,280x720, 4xAA, High detail
Battery life	Run time in minutes for continuous video playback

### SMARTPHONES/TABLETS

Battery life	Run time in minutes for continuous video playback
--------------	---

### PRINTERS AND MFPs

Mono text speed	Pages per minute for correspondence-quality text
Mixed colour speed	Pages per minute for presentable text and graphics
Mono page cost	Running costs expressed as pence per page
Colour page cost	Running costs expressed as pence per page

### DIGITAL CAMERAS

Battery life	Number of shots from full charge
--------------	----------------------------------

### CAMCORDERS

Battery life	Run time in minutes for recording
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### MP3 PLAYERS

Battery life	Run time in minutes for continuous playback
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### ROUTERS

Laptop 24GHz 10m	Mbit/s at 10m with 802.11n laptop on 24GHz band
Laptop 24GHz 25m	Mbit/s at 25m with 802.11n laptop on 24GHz band
Laptop 5GHz 10m	Mbit/s at 10m with 802.11n laptop on 5GHz band
Laptop 5GHz 25m	Mbit/s at 25m with 802.11n laptop on 5GHz band
802.11ac adaptor 10m	Mbit/s at 10m with an 802.11ac adaptor
802.11ac adaptor 25m	Mbit/s at 25m with an 802.11ac adaptor

### NETWORK-ATTACHED STORAGE

Large files	Average MB/s for read/write of 100MB large files
Small files	Average MB/s for read/write of 100MB small files

### HARD DISKS

Extra large files	Average MB/s for read/write of a single 2.5GB file
Large files	Average MB/s for read/write of 2.5GB of large files
Small files	Average MB/s for read/write of 2.5GB of small files

### PROCESSORS

Windows overall	Average speed across numerous demanding tasks
Multitasking	Speed when running simultaneous applications
Dirt Showdown (720p)	Frames per second at 1,280x720, 4xAA, High detail

### MOTHERBOARDS

Windows overall	Average speed across numerous demanding tasks
Multitasking	Speed when running simultaneous applications
Dirt Showdown (1080p)	Frames per second at 1,920x1,080, 4xAA, Ultra detail
Dirt Showdown (720p)	Frames per second at 1,280x720, 4xAA, High detail

### GRAPHICS CARDS

Dirt Showdown (1080p)	Frames per second at 1,920x1,080, 4x MSAA, Ultra detail
Tomb Raider	Frames per second at 1,920x1,080, SSAA, Ultra detail
Metro: Last Light Redux	Frames per second at 1,920x1,080, SSAA, Very High detail

## BENCHMARKS

### SHOPPER BENCHMARKS

Our benchmark suite uses open-source software that runs on Windows, Mac OS X and Linux systems. This lets us use objective results to compare PCs and laptops, no matter which operating system they run. It's designed to test each computer to its limit, using a combination of intensive image-editing, video-encoding and multitasking tests.

We ran the tests on our reference PC, which has an Intel Core i5-4670K processor, 8GB of DDR3 RAM and an AMD Radeon R7 260X graphics card. We normalised our results so this PC had a score of 100. This makes it easy to draw comparisons between test systems.

The resulting overall score is shown at the bottom of every PC and laptop review. As we use the same tests in our standalone and group test reviews, you can compare the performance of any computer, whether it's a netbook, laptop or desktop, from both sections of the magazine.

To see how your computer compares, you can download the suite from [www.shopperdownload.co.uk/benchmarks](http://www.shopperdownload.co.uk/benchmarks). Versions are available for 32-bit and 64-bit operating systems.



### 3D BENCHMARKS

#### DIRT SHOWDOWN

Dirt Showdown is a cracking racing game that makes good use of DirectX 11's fancy graphical effects. You'll want at least 30fps for smooth racing.



#### TOMB RAIDER

With the ultra-demanding Super-Sampling Anti-Aliasing (SSAA) enabled, 2013's Tomb Raider reboot is a great indicator of mid-range performance.



#### METRO: LAST LIGHT REDUX

Our most demanding graphics test uses tessellation, SSAA and massive textures to give even high-end cards a thorough workout.



## RATINGS & AWARDS

Computer Shopper rates products out of five:

Avoid	☆☆☆☆☆
Below average	☆☆☆☆☆
Good	☆☆☆☆☆
Very good	☆☆☆☆☆
Excellent	☆☆☆☆☆

The best products can win the following awards:

### BEST BUY

Products with outstanding quality and performance for the money win our Best Buy award.



### RECOMMENDED

Products that don't quite qualify for a Best Buy award but are still highly rated by our reviewers.



### BUSINESS

The very best products for work win our Business Buy award.





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OR SEE PAGE 126**

# Free software guide

Your free gifts are now even easier to enjoy. Just download all the software from [www.shopperdownload.co.uk/332](http://www.shopperdownload.co.uk/332) and register with your unique coupon code



## Auslogics BoostSpeed 8

**AUSLOGICS BOOSTSPEED IS** a comprehensive suite of tools that will improve performance in just about every area of your PC's operations.

If your system is slow to boot, for instance, then you can use the Startup Manager to locate and disable unnecessary Windows startup programs or Explorer extensions. BoostSpeed can also highlight 'dangerous' items – programs it believes may be spyware – for an additional security benefit.

Nothing slows down a PC quite as much as a poorly optimised hard disk, but BoostSpeed makes it easy to get your system back into shape. There are tools to remove junk and leftover files, clear your web, Windows and application histories, and explore your drive to see which folders are consuming the most space. After that, the excellent Auslogics Disk Defrag application will rearrange your files to deliver the best possible performance.

There are also tools to clean up and then defragment the Registry, and a module to speed up your internet connection; you can tweak these settings manually, if

you know what you're doing, or you can simply let BoostSpeed handle all the tricky decisions for you.

You also get plenty of bonus functions that aren't strictly performance-related, but are still worth having. These include modules to undelete files, discover and fix hard disk problems, view system information, securely shred data or wipe entire hard disks to make sure any personal data they contained has gone forever.

If browsing all these modules sounds too much like hard work, don't worry: just launch a System Scan and BoostSpeed will automatically and quickly identify Registry problems, leftover hard disk junk, file fragmentation and more. After the scan you can have the program fix all these problems in just one click.

Alternatively, the System Advisor module can scan your PC for unwanted programs, surplus services and misconfigured settings, recommending tweaks and automatically applying them on demand.

BoostSpeed also has other key features, in particular its Live Speedup module. A Disk Priority Manager optimises applications in real time, your hard disk is monitored to prevent file fragmentation, while disk and Registry cleanups can now be run automatically.

Elsewhere, a Desktop Protection tool prevents system library errors and reduces system crashes. Privacy improvements include a tool to help detect visits to sites containing adult content. This latest version also brings a host of smaller improvements to enhance the program's effectiveness, fix bugs, improve configurability, and generally ensure it does an even better job of boosting your PCs performance.

**REQUIREMENTS** Windows XP, Vista, 7 or 8 32/64-bit, 100MB hard disk space

**WEBSITE** [www.auslogics.com](http://www.auslogics.com)

**NOTES** Get your registration code at [boostspeed7.disc.computershopper.co.uk](http://boostspeed7.disc.computershopper.co.uk)

### GETTING STARTED

The download instructions on the opposite page show you how to connect to the download site. Please make sure that you type in the web address exactly as shown. You'll need your coupon code the first time you log on.

### ANY PROBLEMS

If you need help with any of the software this month, please send an email to [letters@computershopper.co.uk](mailto:letters@computershopper.co.uk). We check this inbox regularly. Please include the issue number of the magazine and your coupon code.

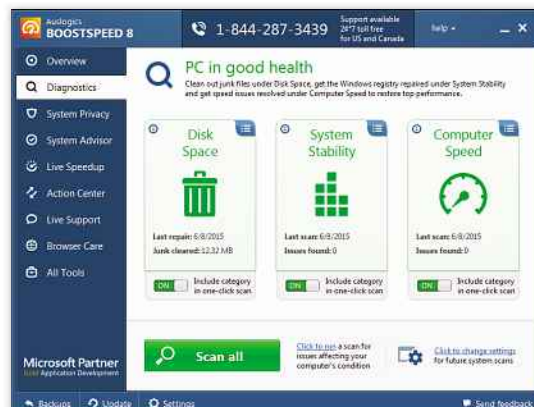
### WHY DOWNLOADS

Software manufacturers have been requiring us to use online registration for some time now, but increasingly we're being asked to provide the program as a download. In order to continue bringing you the best free software, we've revamped our download site. You need to use the unique code printed in the box on the facing page to register and download the software in this issue.

The unique code means we stop the deals leaking online, so only Shopper readers get the software. You'll also enjoy a smoother registration, where we handle the registration process.

### NO CODE?

If you don't have the card insert with the unique code, you must buy the £4.99 print version of the magazine. If you have bought this, please contact [letters@computershopper.co.uk](mailto:letters@computershopper.co.uk) for help and a new code.





## Chat and Communication

**Digsby (Build 92)** Access all your instant messaging services from one application; there's support for Windows Live!, Yahoo!, AIM, Google Talk, ICQ and Jabber.

**Evernote 5.8** Store your notes, ideas and plans in the cloud, and synchronise them between computers.

**UPDATED Mozilla Thunderbird 38.1 A** powerful email client from the organisation best known for the Firefox web browser.

**Postbox Express 1.0** An email client that provides a comprehensive array of tools to help you manage your messages more easily.

**UPDATED Skype for Windows 7.6** Make internet voice and video calls for free, and buy credit to make calls to mobiles and landlines.

**Trillian 5.6** Use all your instant messaging accounts with one application; this program has support for Windows Live!, AIM, Yahoo! and Google Talk.



## Customisation

**7 Taskbar Tweaker 4.5** Customise the Windows 7 taskbar so that it works exactly to your liking.

**Metro UI Tweaker for Windows 8** Tweak the new user interface for Windows 8.

**Mosaic Desktop Beta 1 Refresh** Add Windows 8's mosaic-tiled desktop to your computer without having to upgrade.

**Rainmeter 3.2** Customise the desktop quickly and easily with your choice of information, tools and shortcuts.

**Windows 8 Transformation Pack 9.1** Emulate the look of Windows 8 on an earlier version of the operating system.

**UPDATED Windows 10 Transformation Pack 4.5** Bring some of Windows 10's new features to your current operating system.



## General

**Free Studio 6.5** This software provides an easy way to convert your video and audio files into different formats.

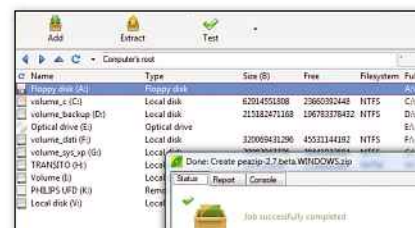
**UPDATED Paragon Partition Manager 14** Free Create, format, split, merge and reorganise all your hard disk's partitions.

**PeaZip 5.6** A tremendously powerful archive-management tool.

**Screenshot Captor 4.1** Create and manage screenshots the easy way.

**UPDATED SUMo 4.0** Quickly scan your PC's installed applications and find any updates available for them.

**ZipGenius 6.3** A flexible file-compression tool with support for a huge number of compressed file formats.



## Internet and Network

**CarotDAV 1.1**

Manage all your online storage services with one simple application.

**Cyberduck 4.7**

A powerful but easy-to-use FTP client for uploading and downloading your files.

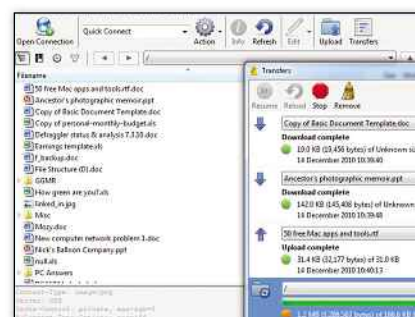
**Easy WiFi 4.0**

Find free Wi-Fi hotspots while you're out and about.

**UPDATED NetBalancer 8.7** Make the most of your internet connection by assigning download and upload priorities to web applications.

**TeamViewer 10.0** Remote-control your computer from anywhere in the world.

**Vuze 5.6** A BitTorrent client to help you locate, share and download torrent files.



## Tweaking and Performance

**CCleaner 5.0** Remove unwanted information, temporary files, browsing history, huge log files and even the settings that uninstalled software leaves behind.

**Defraggler 2.1** Ensure your system is defragmented properly and improve its performance.

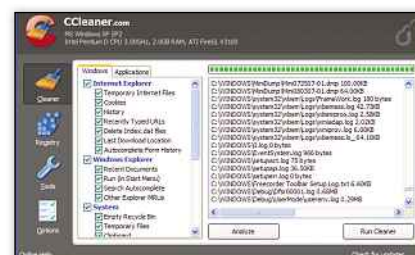
**Finestra Virtual Desktops 2.5** Set up four or more virtual desktops on your PC.

**IObit Advanced SystemCare 8.3**

A complete computer security, maintenance and optimisation suite.

**Revo Uninstaller Free 1.9** Remove installed applications completely, including all their folders, system files and Registry entries.

**Simple Performance Boost 1.0** Tweak the Windows Registry to give your PC a performance boost.



## Crafting PCs the Scan way: Specification. Service. Satisfaction.

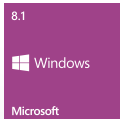


### Scan V1 Value System Home / Office PC

- Intel® Pentium® G3240 processor
- 4GB Corsair DDR3 1333MHz memory
- 500GB SATA 6Gb/sec hard drive
- Windows 8.1

**£299** Inc VAT

The V1 is a very capable entry-level system perfect from basic home/office tasks. It's based around the dual-core Intel® Pentium® G3240 processor, 4GB of RAM plus a 500GB hard disk.



### Scan V15 Value System Home / Office PC

- Intel® Core™ i5 4460 processor
- 8GB Corsair DDR3 1600MHz memory
- 1TB SATA 6Gb/sec hard drive
- Windows 8.1

**£475** Inc VAT

The V15 ups the ante by including a quad-core Intel® Core™ i5 4460 processor, so it makes light work of office and multimedia applications.



### Scan G20 Value System Gaming PC

- Intel® Pentium® G3240 processor
- 8GB Corsair DDR3 1600MHz memory
- 2GB NVIDIA GeForce GTX 750 Ti SSC
- 1TB SATA 6Gb/sec hard drive
- Windows 8.1

**£479** Inc VAT

Thanks to its dual-core Intel® Pentium® G3240 processor and NVIDIA GTX 750 Ti SSC graphics card the G20i is our most affordable gaming PC. It even includes surround sound!



### Scan G30i Value System Gaming PC

- Intel® Core™ i5 4460 processor
- 8GB Corsair DDR3 1600MHz memory
- 2GB NVIDIA GeForce GTX 960 SSC ACX
- 1TB SATA 6Gb/sec hard drive
- Windows 8.1

**£659** Inc VAT

The combination of quad-core Intel® Core™ i5 4460 processor and NVIDIA GeForce GTX 960 SSC ACX graphics card ensures that the G30i can play any game you throw at it.



## Get the best of work and play with the new Windows.



### Scan Value PCs

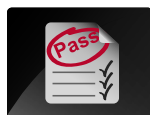
A range of computers perfectly suited for the home/office. These affordable PCs are very flexible workhorses, capable of every task, from email/web surfing to high-end applications such as photo editing, video encoding and gaming. All of our Value Systems are pre-built and soak-tested so are ready to ship for next-day delivery.



Finance Available on  
PCs above £300



Built by award  
winning 3XS team



Fully soak tested



Fully 3XS  
compatible



Ready to ship



2 Year Warranty  
Part + Labour





## The most awarded PCs and Laptops Period.



### Scan 3XS Gamer 20i Gaming PC

- Intel® Core™ i7 4790 processor
- 8GB Corsair DDR3 2133MHz memory
- 4GB NVIDIA GeForce GTX 970 SC ACX
- 1TB Seagate HDD
- Windows 8.1
- 3 Year Premium Warranty

**£999** Inc VAT

The 3XS Gamer 20i is a super-fast gaming PC thanks to its combination of quad-core Intel Core i7 4790 CPU running at 3.6GHz with added Hyper-Threading plus a 4GB NVIDIA GeForce GTX 970 graphics card. These components are installed in an Asus Z97-K motherboard along with a 1TB hard disk.

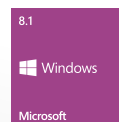


### Scan 3XS Z97 Vengeance Gaming PC

- Intel® Core™ i7 4790K processor overclocked up to 4.7GHz
- 8GB Corsair DDR3 2133MHz memory
- 4GB NVIDIA GeForce GTX 980 SC
- 250GB Samsung 850 SSD & 2TB HDD
- Windows 8.1
- 3 Year Premium Warranty

**£1445** Inc VAT

This high-end gaming system includes a water-cooled Intel Core i7 4790K CPU overclocked up to 4.7GHz plus a 4GB NVIDIA GeForce GTX 980 graphics card, 8GB of 2133MHz Corsair Vengeance Pro DDR3, 250GB SSD for lightning quick gaming loading and a 2TB hard disk.

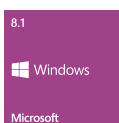


### 3XS Graphite LG157 Gaming Laptop

- Intel® Core™ i7 4720HQ processor
- 8GB Corsair DDR3 1600MHz memory
- 2GB NVIDIA GeForce GTX 960M
- 15.6in 1,920 x 1,080 screen
- 1TB SATA 6Gb/sec hard drive
- Windows 8.1

**£869** Inc VAT

The LG157 is a 15.6" mid-range gaming laptop that includes a NVIDIA GeForce GTX 960M graphics card plus an Intel Core i7 4720HQ CPU, up to 16GB of RAM and multiple hard disks and SSDs. The LG157 is ready for next-day delivery and is protected by a 2 Year Premium Warranty.

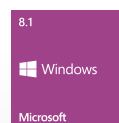


### 3XS Graphite LG1720 Gaming Laptop

- Intel® Core™ i7 4720HQ processor
- 8GB Corsair DDR3 1600MHz memory
- 3GB NVIDIA GeForce GTX 970M
- 17.3in 1,920 x 1,080 screen
- 1TB SATA 6Gb/sec hard drive
- Windows 8.1

**£1075** Inc VAT

The LG1720 is a 17.3" high-end gaming laptop that includes a choice of powerful NVIDIA GeForce GTX 970M or 980M graphics card, ensuring silky smooth frame rates in all games. The LG1720 is ready for next-day delivery and has a 2 Year Warranty.



## Scan Computers recommends Windows.

### 3XS Custom Series

Our 3XS Custom Series is a range of computers designed to offer the best performance for a variety of applications, with a particular focus on games. We build Custom Series PCs to order, so we can configure and tailor make an individual PC just the way you want it. We can also overclock the processor, so you get a faster PC without a substantial increase in price. All 3XS Custom Series PCs are covered by a three year warranty as standard with the first year on-site.



Scan 3XS Overclocked



Built by award winning 3XS team



3 Year Warranty

# 3XS SYSTEMS



# HOME CINEMA

## Online film and TV services

With your local video shop now probably no more than a distant memory, where do you go to watch films and TV shows? We test nine of the largest online rental services to sort out the blockbusters from the turkeys

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**TALKTALK** Blinkbox

**THE EXPERIENCE OF** popping down to the local Blockbuster to rent the latest DVD and pick up a slightly overpriced tub of popcorn took a pretty big hit in 2013 as the rental giant's last 91 UK stores were closed as the company went into administration.

It was the end of an era for high-street video shops; there are still a few independents dotted about, but the market is now dominated by digital film services such as Amazon and iTunes. Blockbuster didn't move quickly enough to combat these services, so if you want to rent a video, you have to go online.



Online video services cater for pretty much every internet-connected device you can think of. According to the British Video Association, in 2014 81% of video rentals were made online, with the rest taking the form of DVDs and Blu-rays. Such a large choice of services is great for the consumer, as we show over the next 12 pages, but no single online film and TV service serves everyone perfectly well.

Because these services don't require subscriptions and each rental or purchase is a one-off payment, you can chop and change between each one depending on your needs. For example, if you want to download films to your Android tablet to watch offline on a long journey, Google Play Films & TV is your best bet. If you want to watch something on your Sony Bravia TV or PS4, PlayStation Video is the way to go. Want all the bonus features you can shake a stick at? It's all about iTunes.

### LICENCE TO CONFUSE

Licensing restrictions will sometimes mean standard-definition (SD, 480p) content is only available on certain platforms. This means that even if you've paid around £1 extra for a high-definition (HD) rental, you might not get what you paid for if you're watching on a device that is only licensed for SD content. This has nothing to do with your playback device's screen resolution; in many cases even devices with HD screens will only be allowed to play SD content. If you pay extra for HD and can't play it, you'll probably be able to claim a refund, but it's still an irritation. Our table on page 90-91 shows which devices support SD or HD on which services.

The online video services consider any resolution above 1,280x720 as 'HD', and it's not always clear if the HD you've paid for will be 720p or proper 1080p Full HD. Some services are upfront about their maximum resolution, and others are more cryptic or, if you contact customer support, uncertain.

### CONTENT IS KING

If you want the latest big-name films, you'll get the same titles at pretty much the same time for the same price on every service we've reviewed. Typically, major releases will appear as 'digital pre-releases', which are available to buy, but not to rent, for around £9.99 for a week. They later become available to rent for around £4.49; see 'Timeline of a film', right.

There is more differentiation between services when it comes to TV programmes. Because there are so many broadcasters and production companies that control the rights to TV shows, their availability varies between services. It's also worth shopping around, because the cost of buying a complete series (you can't rent TV programmes on these services) can often vary by several pounds.

Buying video online may be convenient, but there are some reasons to remain a bit suspicious. In most cases, 'buying' a film to keep in your online library is simply the service licensing that video to you. If the service loses the rights to that video, you will

## TIMELINE of a MOVIE

### THEATRICAL WINDOW

This is still the first port of call for most big-name films. As modern multiplexes can show a number of titles at once, films can now play in cinemas for eight weeks or more.



### BLU-RAY AND DVD PURCHASE WINDOW

This is the point at which the film goes on sale in shops. Originally this was six months after cinematic release, but the pressures of online piracy and shrinking DVD sales have brought this down to around four months.

### FIRST SUBSCRIPTION PAY-TV WINDOW

This is the first stage at which the film is available to those who pay a subscription fee for a service – in other words, it's the first time you can watch the film without specifically paying for it. This window has been dominated by Sky and its movie channels in the UK, but online services are now competing for these rights. Films are typically available less than a year after their cinematic release.

### FREE-TO-AIR WINDOW

This is the point at which films appear on the BBC, ITV and other Freeview channels. It typically occurs around two-and-a-half years after the film's cinematic release. At this point, the films become available for more general, non-exclusive, licensing, so you may find that they're available on more than one online video service.



### DIGITAL EARLY RELEASE

Some films will be available for purchase on digital services before they appear in physical shops, often at least a week before general release. You can't usually rent these titles during this period, however.



### RENTAL AND PAY-PER-VIEW WINDOW

At this stage, the film becomes available to rent on disc (from any of the high-street shops still in existence, or from LoveFilm). This window now often coincides with the pay-per-view release, which is essentially just online rental. After this window, there is often a two-month withdrawal from pay-per-view services to help build up expectation for the subscription window (below).



### SECOND SUBSCRIPTION

This new window has come about with the appearance of online video services. Online providers have been looking for content that's not available on free-to-air channels, but they don't generally have the might to compete with Sky for the first subscription window. Such deals fill in the gap between the first release windows and the final free-to-air release, and often begin around 21 months after the film comes out in cinemas.



too and will no longer be able to play it. Some services allow you to download a video to your device, but this is still no way to guarantee you'll be able to watch it forever; many services still make you connect online periodically to retain access to the content, and the locked-down nature of these services means you won't be able to transfer your video to another device.

Another way to avoid losing access to your content is through UltraViolet ([www.myuv.com](http://www.myuv.com)). This cloud-based digital rights service

takes your purchases from partaking retailers and combines them into one library. Of the services we tested, Wuaki.tv, Sainsbury's Entertainment and Blinkbox work with UltraViolet. This means titles you buy from these services go into your UltraViolet library and, according to UltraViolet, your rights for these films will never expire. However, you still have to activate each video on a certain compatible service, and it will then be locked to that service, so this may still limit the devices on which you can watch your content. ➔

## AMAZON Instant Video



[www.amazon.co.uk/instantvideo](http://www.amazon.co.uk/instantvideo)

HD film (rent/buy): £4.49/£13.99

SD film (rent/buy): £3.49/£9.99

### VERDICT

Amazon has an impressive catalogue of films and TV, but an inconsistent mobile experience limits its appeal

**AMAZON HAS BECOME** a big player in the world of streaming TV and films, slowly but surely catching up Netflix with a growing roster of original content and crowd-drawing TV programmes such as *The Walking Dead*, *Six Feet Under* and *Boardwalk Empire* included in its £79-per-year Prime subscription service.

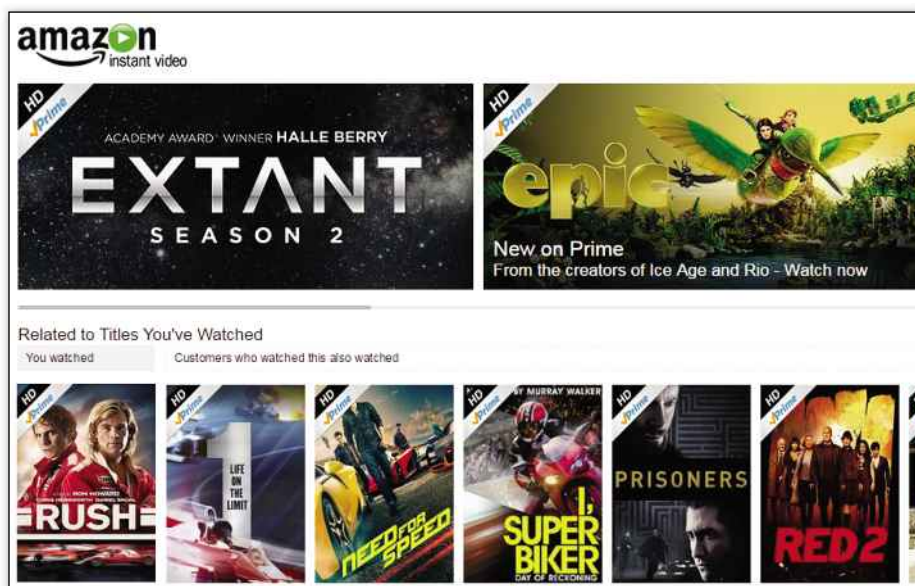
When it comes to pay-per-view streaming, however, Amazon holds less of an advantage in terms of exclusive content, more or less matching its major rivals both in variety and pricing for the latest TV shows and films.

### CONTENT

It's worth pointing out the differences between Amazon Instant Video and Prime Instant Video. If you're a Prime subscriber, you get a selection of TV programmes and films included with your subscription, including Amazon Originals such as *Bosch*, *Mozart in the Jungle* and *Transparent*. Some recent blockbuster films are also included (such as *The Wolf of Wall Street* and *The Imitation Game*), but to watch the more recent *American Sniper*, you'll have to pay the full rental or purchase price on top of your Prime subscription. At last count, there were just over 16,000 films available on Prime Instant Video for no extra cost, while the full Amazon Instant film library exceeds 88,000 titles.

Popular TV programmes such as *Revenge*, *Suits* and *Game of Thrones* are also available, and you can buy season passes for ongoing series. This allows you to buy the full series for a fixed price instead of having to buy each episode individually as they become available. TV shows typically cost £2.49 per episode in HD, with full HD seasons costing between £22.99 and £32.99. Buying a full season is always better value than buying each episode individually, especially with US TV series, which often exceed 20 episodes per season.

Films are available both to buy and rent, although brand-new releases don't have a rental option, meaning you'll either have to wait or buy them outright. £4.49 to rent and £13.99 to buy a new film in HD is par for the course. Rentals have a 30-day time limit, although once you press play for the first time you have 24 hours to finish watching. This is half the 48 hours you get with most other services, which puts the pressure on you to watch the film in one sitting rather than on consecutive nights.



Films around two years old tend to be cheaper, although their availability and quality varies much more widely than it does with the latest flicks. Some films, such as 2013's *Star Trek: Into Darkness*, are only available to buy outright for £5.99, and can't be rented. The original *Star Trek* reboot from 2009, however, is available to rent for £2.49 in SD and £3.49 in HD. Meanwhile, only three of the eight Harry Potter films are available in HD. This means that while Amazon's catalogue is an admittedly large box of chocolates, you're never quite sure what you're going to get.

Not all films and TV programmes have subtitles, although many of them do. The best way to find out whether a video has subtitles is on the store page, where it's clearly marked. Impressively, you can customise how subtitles are displayed. Some, but not all, films come with Dolby 5.1 surround sound, and this is again clearly marked on the film's store page.

### PLATFORMS

Amazon Instant Video is available on a wide range of operating systems and devices, although each has its own limitations and quirks. For example, you can watch TV programmes in HD in your browser on both Windows and Mac OS computers, but you can only get HD films on Windows PCs, while Mac devices are limited to SD.

The film experience is poor for users of non Amazon-branded Android devices. You're limited to SD streaming with no downloads, and you have to open videos through your device's web browser instead of an app. This is a huge departure from the seamless experience you get on Amazon Kindle Fire tablets and Fire phones, where you can buy and watch content in HD and download content for watching on the move without a Wi-Fi or mobile data connection.

iPhone and iPad users get a better deal. You can stream in HD and download videos in SD to watch later, which is useful if you're going on a long trip without a data connection. You can't buy content from

within the app, though, so you'll need to use your web browser to make any purchases before watching them in the app.

Amazon also has a decent presence on Smart TVs and Blu-ray players, with devices from Sony, Samsung and LG all supporting the service. PS3, PS4, Xbox 360, Xbox One, and Wii U console owners can all stream Amazon Instant Video in HD, and Wii owners aren't left out, though they can only watch in SD. If you don't have a Smart TV, you can buy an Amazon Fire TV Stick for around £35 or a Fire TV set-top box for around £79 to give you access to the full range of Amazon's content on your TV. The Fire TV Stick in particular is superb value, and it won a Best Buy award when we reviewed it in *Shopper* 331.

Although you can buy most films and TV programmes in HD and SD formats on Smart TVs, the quality of the content you receive will vary depending on your playback device and the speed of your internet connection. Amazon doesn't say which HD resolution it uses; there's no label to differentiate 1080p and 720p content. Check your device is compatible with Amazon's HD streams before shelling out for HD content. You can find the full list at [tinyurl.com/amazoninstanthd](http://tinyurl.com/amazoninstanthd).

Usefully, all the various platforms support WhisperSync, so you can stop watching on one device and continue on another from where you left off, without having to go through the video to find where you'd got to.

Amazon Instant Video has a great variety of films, TV series and a growing roster of original content available on a huge array of devices and, even if you don't have a compatible device, you can always upgrade your TV with an inexpensive Fire TV stick. However, mobile device support is much less impressive unless you own an Amazon-branded tablet, and are willing to put up with the accompanying restricted version of Android for the sake of your video watching.

**BEST FOR** Amazon Prime subscribers, Kindle Fire and Fire TV owners



# APPLE iTunes

COMPUTER SHOPPER  
RECOMMENDED



www.apple.com/uk/itunes/video

HD film (rent/buy): £4.49/£13.99

SD film (rent/buy): £3.49/£9.99

## VERDICT

A huge range of content and bonus features, along with 1080p video, make iTunes the best destination for dedicated film fans

**ITUNES IS NOW** an elder statesman in the world of TV and film rentals, having served up pay-per-view TV for almost a decade and films from the big studios for seven years.

Apple dominates the online film rental market, with a huge 85,000-strong library. Add a catalogue of 300,000 TV episodes, and you have more video content that you could possibly watch in a lifetime, all in one place.

Apple is picky about which platforms you can use to watch its content. It begrudgingly lets you watch films and TV programmes on your Windows PC, but aside from that you won't find iTunes on your Smart TV, games console set-top box or Android device. There isn't even a web-based player. However, the huge range, along with Full HD content, make iTunes a strong contender even if you have to buy some extra hardware to use it.

## CONTENT

iTunes has a huge range of films in its line-up, including new titles from smaller studios you won't find on other services, and some classics; *Rain Man*, for example, is only hosted by a handful of services, of which iTunes is one.

## Apple iTunes is a superb service with more bonus content than any other provider

Apple has deals with all the major film studios, too, so you're unlikely to find a new film that isn't on iTunes. Film pricing is in line with the rest of the streaming services: you'll pay £4.49 for an HD film rental and £13.99 to buy it outright. TV is slightly more expensive: *Game of Thrones* Season 5 will set you back £23.99, 50p more than on Google Play and £1 more than Amazon, Blinkbox and PlayStation Video. There are lots of TV 'box sets' available, which is a great way to get a big discount on a series if you know you're going to watch the lot. You can buy the complete set of *Game of Thrones* Seasons 1-5 in HD for £90, which is £26 cheaper than buying each season separately. Not all series are available in box sets, however, so most programmes will have to be bought as individual seasons.

With many services, when you buy a single episode of a TV programme to try it, buying the whole season means paying full price and buying all the episodes again, even if you



already own the first one or two. iTunes does things differently. Its Complete My Season tool lets you buy the rest of a season for a discounted price. Buying two £24.99 episodes of a £19.99, 23-episode season of *Brooklyn Nine-Nine* netted us a £4.98 discount on the cost of the full season. Complete My Season acts in the same way as buying a full season, so you get all the bonus features that come with the series, such as cast interviews.

Bonus features are also available with films. These DVD extras-style features, which come under the iTunes Extras label, are only available if you buy a film outright in HD. This is a rare thing in the UK and elevates iTunes well above its rivals for film buffs who want all the behind-the-scenes footage they can find.

TV programmes and films are available in SD and HD, with 720p and 1080p options available, and it's up to you what quality you

need for a web-based store or streaming service. Any video can be downloaded in 1080p, although you'll have to enable this in the Preferences, Store setting, as by default all content is downloaded in 720p. This setting also affects how items are downloaded to your iOS devices. It's a strange way of going about things, as changing your iTunes settings on your PC may not always be possible. This could be a pain if you want to download a film on the move and don't want to pull down a large 1080p file over a public Wi-Fi network. The Apple TV box doesn't let you download films, so relies on a decent broadband connection; Apple recommends at least 2.5Mbit/s for SD, 6Mbit/s for 720p and 8Mbit/s for 1080p playback.

iTunes lets you know when enough of a film has been downloaded to watch smoothly, so those with fast internet connections will be able to start watching almost straight away, while those with slower connections are guaranteed interruption-free playback.

On iOS devices, the iTunes app is the place you'll buy content. Once you've bought an item, you'll have to open it in the Videos app to stream or download it. The Videos app is rather simplistic and doesn't feel like a great hub for all your digital video content, but it does a fine job playing videos. You can play videos in HD on 4th-generation iPod Touch, iPhone 4 and the first iPad and above. 1080p videos are also supported by third-generation (2012) Apple TVs, while first- and second-generation Apple TV boxes can handle 720p.

Apple iTunes is a superb service with more bonus content than any other provider. The addition of Complete My Season and Full HD video make it tremendously attractive, especially when you consider that, for the most part, content costs the same on iTunes as it does elsewhere. However, we'd avoid using iTunes on Windows due to the potential performance problems; if you want to use the iTunes service for video, you're best off spending £49 on an Apple TV.

**BEST FOR** Film buffs and iOS, Mac and Apple TV owners

# GOOGLE

## Play Films & TV

COMPUTER SHOPPER



RECOMMENDED

play.google.com/store/movies

HD film (rent/buy): £4.49/£13.99

SD film (rent/buy): £3.49/£9.99

### VERDICT

A variety of supported platforms and useful extra features make Google Play one of the most fully featured streaming services

**LIKE MICROSOFT FILMS** & TV and Apple iTunes, Google Play has a large customer base thanks to its presence on all new Android phones and tablets. You'd therefore expect the best experience to be when watching on the move on an Android handset or an Android-powered TV, but those watching on other platforms are also fairly well covered.

### CONTENT

Google Play has a well-organised and easy-to-use library of films and TV shows, with filters for the most popular content and the newest releases. You can also filter by age rating, genre, film studio and TV network, so it's easy to sort through the catalogue.

You're also shown user ratings for every film, and hovering over each item on the desktop website reveals a 'play' button that lets you view a trailer, if one is available. This means you can shop around the storefront without having to navigate back and forth between the store and product pages.

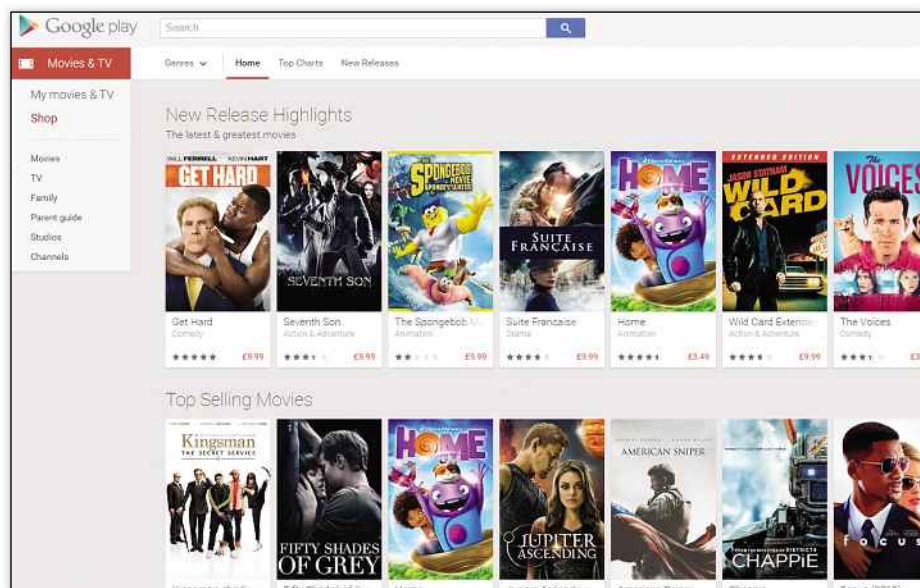
Suggestions based on your previous purchases are heavily promoted, although until you've watched a lot of films you'll probably end up with a fair number of

Simply pause a video, and any actors on screen will be labelled. Tap or click that actor, and any production they've been in will be displayed

left-field suggestions that you're not interested in. You're also encouraged to rate your recent purchases, which will also feed into the film recommendations.

Pricing is largely on a par with other streaming services, with an HD film priced at £4.49 to rent and £13.99 to buy. New TV series are slightly more expensive at £23.49 for popular programmes such as *Game of Thrones*, which is 50p more expensive than most other services but 50p cheaper than iTunes and Microsoft Film & TV. You get 30 days to watch a rental, and 48 hours to finish it once you've started watching.

Films and TV programmes are available at a maximum 1080p resolution, although



Google doesn't make it clear what quality you're watching or which resolution you'll receive on which device. At the very least you can expect 720p on most devices, providing your internet connection speed is fast enough. Where available, films and TV programmes are provided with Dolby 5.1 surround sound, and English subtitles are also available. This information is clearly marked on the store page before you buy.

### PLATFORMS

Despite Google's heavy focus on mobile, its browser-based viewing options are satisfactory. Those on Windows using the Google Chrome browser are guaranteed 'HD' quality providing they're using a laptop or an HDCP-compliant HD display but, as mentioned above, it's not clear whether this is 720p or 1080p. Things are more complicated if you're an Apple customer. Mac laptop users

your device's YouTube app. To do this, you must sign into your account and scroll down to Purchases in the menu bar on the left of the screen. From here, you'll be able to find all your content and, if your internet connection is fast enough, you'll be able to watch it in Full HD. It's a bit of a convoluted process that Google fails to mention in its own help files, which is a shame. Furthermore, older TVs from 2012 and before don't have access to purchased content, so you'll need to buy a Chromecast, a games console or upgrade your TV to get access to your library. You could also buy a Roku streaming stick or box and install the Google Play app.

Google Play is undoubtedly at its best on Android, as this is the only platform on which you can download videos to watch later; you simply buy content from within the Play Store, and then use the Play Films & TV app on your device to watch them.

One of the best features of the Chrome, Android and Roku video players are the 'info cards', which resolve the age-old 'where have I seen that actor before?' feeling many of us get when watching films and TV programmes. Simply pause a video, and any actors on screen will be labelled. Tap or click that actor and any production they've been in will be displayed. If you pause a fraction of a second too late, you'll also be told you 'just missed' any character that was featured in the shot before you paused, so you don't have to wind back to see who they were.

Google Play is an excellent video-streaming service that works best in the Chrome browser and on Android devices. With Full HD video available to download for offline playback on Android, it's the perfect service if you're going on a long journey and want something to keep boredom at bay. Google Play is clunkier on Smart TVs, and Apple owners are better off with iTunes, but this is still one of the best services out there.

**BEST FOR** Android tablet, smartphone and TV owners

with Chrome get HD content, but those using an Apple desktop such as the iMac, Mac Pro or Mac Mini will only be able to watch in SD. iOS users aren't quite so well served; you can only watch in SD, although you are able to download content for offline viewing.

There aren't any native Smart TV Google Play apps. If you have a £30 Chromecast dangle this isn't a huge issue, but those who want to keep their TV as uncluttered as possible will sigh at the prospect of adding another device to their home cinema setup.

Luckily, there's a workaround. If you have a PS3, PS4, Xbox 360, Xbox One, Wii U or a Smart TV from 2013 or later, you can watch your rented and bought content from within



## MICROSOFT Films & TV (AKA Xbox Video)



video.xbox.com

HD film (rent/buy): £4.95/£13.99

SD film (rent/buy): No/£9.99

### VERDICT

A fine service with decent quality video, but rentals are painfully inflexible

**MICROSOFT FILMS & TV** is suffering from an identity crisis. Depending on what device you use to access it, it has a different name. On Windows 8.1 and Windows Phone 8.1 it's called Videos (but the storefront is labelled Xbox Video), on Windows 10 and Windows Phone 10 it's called Films & TV, while on Xbox consoles and the web it's called Xbox Video. Whatever name it chooses to go by, the content and pricing is the same and the interface design is largely identical, too.

### CONTENT

Microsoft claims a content library of more than 150,000 videos in the UK. The library includes the latest big-name films and TV programmes, and there are also items available for pre-order. Some titles also come with bonus features; the pre-order for this year's *Ted 2* film also comes with a behind-the-scenes featurette, for example.

Pricing on new films is a little higher than most, with new titles costing £4.95 to rent in HD instead of most services' £4.49. Buying an HD film outright typically costs the standard £13.99. TV series follow a similar trend: *Game of Thrones* Season 5, which would normally cost £22.99 to buy in HD, is priced at £23.99



on Microsoft's services. While some items are more expensive, you'll occasionally find some savings; the second half of Season 7 of *Mad Men* is £16.49 in HD, for example, while most other companies charge £16.99 or £17.99.

Microsoft Films & TV content is available in 1080p, although only on certain devices, as explained below. Most content is available in 720p, and some also comes with 5.1 surround sound, although the store pages don't differentiate between stereo sound and 5.1,

### PLATFORMS

The service is unsurprisingly Microsoft-centric, although you can watch on the web in 720p on Windows and Mac (using Silverlight, which doesn't work in Chrome). There's no Android app and no iOS app which, while understandable, is a frustration for buyers who just happen to own a non-Windows smartphone or tablet.

You'll find apps on Windows 8.1 and 10, as well as Windows Phone 8.1 and 10. With the

**You're only allowed to watch a rented video on the device you originally rented it on. It's a bizarre limitation that makes Microsoft's service significantly less attractive**

which will be annoying for those who want to get the most from their high-end cinema system. English subtitles are available on a fair amount of content, but not all. For example, we found there were no subtitles available for the 17 seasons of *Top Gear* available on the service. You'll find whether a title has subtitles by checking for 'CC' (closed captioning) at the bottom of a video's store page.

There are some slightly strange limitations to Microsoft's service. The limitations that apply to rentals are as follows: a rental is for 14 days, not the typical 30 days you get on other services. Even worse, once you press play you only have 24 hours to finish watching, so have little choice but to watch it in one sitting. The worst limitation, however, is that you're only allowed to watch a rented video on the device you originally rented it on. If you rented something on your Xbox 360 one evening, didn't have time to finish that night but had time on your commute to carry on watching the next morning, you wouldn't be able to. You'd have to watch at home in the morning and be late for work, or take your Xbox to work and finish it off at lunchtime, which is highly unlikely. It's a bizarre choice that makes Microsoft's service significantly less attractive.

Windows 8.1 and 10 apps, you can both stream and download to your device to watch offline in 720p quality. The Windows Phone 8.1 app only allows you to stream and download in SD, but the Windows Phone 10 app supports HD playback for the first time.

As the Xbox Video name implies, you can also watch on your Xbox 360 and Xbox One consoles. An Xbox is the only place you can watch your rented and purchased content at 1080p resolution, as long as your devices are connected via HDMI. If you have an Xbox 360 that's using the Xbox 360 Component HD AV Cable, you can view a maximum resolution of 720p or 1080i, neither of which are as sharp as proper 1080p. There's no support for Smart TVs or TV boxes such as the Roku.

Despite offering apps for Windows 8.1 and 10, Microsoft Films & TV is still not the best place to buy and rent TV and films on your PC, due to a 720p cap on resolution; that honour goes to Google Play or iTunes. It is, however, by far the best service to use with your Xbox console, thanks to Full HD resolution and surround sound available for high-end home cinema setups.

**BEST FOR** Xbox and Windows Phone owners

# RAKUTEN Wuaki.tv



uk.wuaki.tv

HD film (rent/buy): £4.49/£13.99

SD film (rent/buy): £3.49/£9.99

## VERDICT

A wide selection of supported platforms but a modest library; Wuaki.tv doesn't offer anything special

**WUAKI.TV IS ONE** of the newer kids on the streaming block, first launched in Spain in 2010. The service arrived in the UK in 2013 after being bought out by Japanese internet giant Rakuten, which also bought Play.com in 2011. Wuaki.tv launched in the UK with a Netflix-style pay-per-month model, but this was quickly abandoned and replaced by its current pay-per-view system in 2014.

The service will likely be familiar to EE customers, as EE now offers one £1 Wuaki.tv rental for its customers every week. This offer took over from the cultural phenomenon that was Orange Wednesdays.

## CONTENT

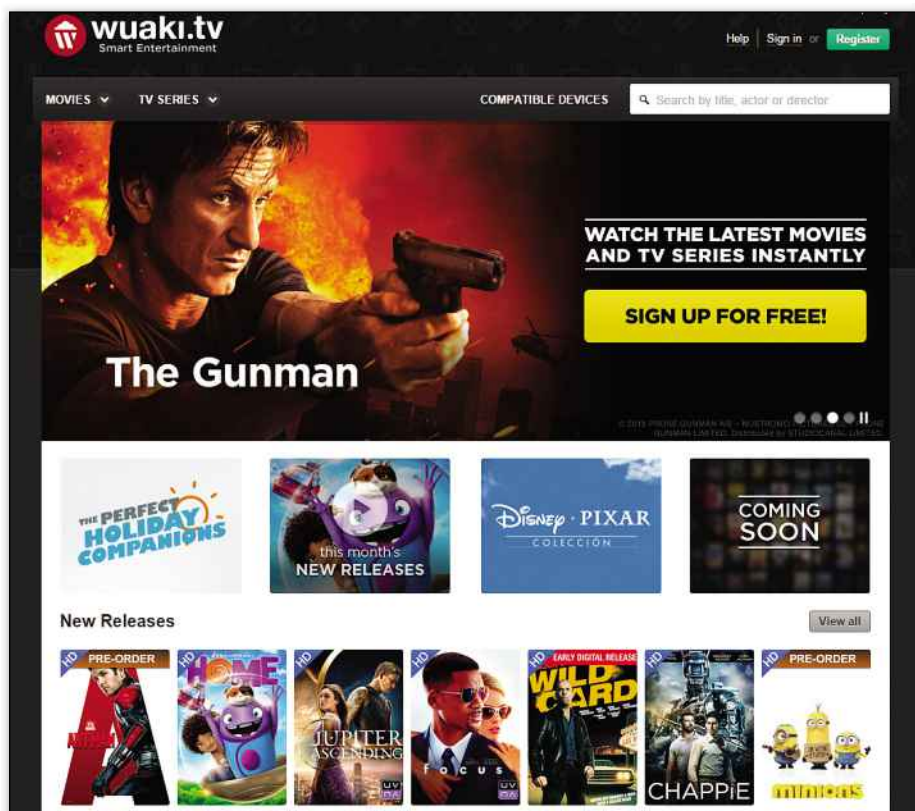
At the last count, Wuaki.tv had 20,000 titles available. How this breaks down between films and TV programmes is unclear, but it's a moderately sized library that consistently has the latest films on offer for both purchase and rental. However, there's a rather large elephant in the room if you're looking to buy a title to keep forever.

'Buying' from Wuaki.tv only licences a piece of content to you for three years, and not a day longer, which makes a mockery of the purchase process. It's not entirely unforgivable, though; all the other services we've reviewed have similar terms and conditions that give them the right to remove content from your library if they lose the rights to it, as we discussed in the buying guide on page 79. It just so happens that Wuaki.tv has put a definite time limit on it.

Essentially, this means your options are a three-year rental or a 30-day rental, although the latter requires you to finish watching within 48 hours once you've pressed 'play', which is common for online rental services.

Pricing is largely in line with other services, with new films costing £4.49 to rent and £13.99 to buy. A new TV programme such as *Game of Thrones* will set you back £22.99 for a full season, and you can also buy a season pass while a series is ongoing, so each episode is added to your library as it becomes available.

Most content is available in HD with stereo sound. Wuaki wouldn't tell us whether 1080p content is available, but it did confirm that HD content is always 720p. Wuaki.tv has started rolling out Ultra HD (4K) content on its Smart TV apps in Europe, but this feature has yet to make it to UK shores.



English subtitles for the hard of hearing are not available on any videos. Wuaki.tv said in February 2014 that it was "actively looking" at subtitles, but there's been no update since then, which is a shame.

## PLATFORMS

Wuaki.tv's strongest suit is its availability on a large number of devices although, as always, there are some limitations. For example, web-browser streaming on both Windows and Mac computers is only in SD. Wuaki.tv claims to offer HD streaming on its Windows 8.1 app, but at the time of writing the app was unable to connect to Wuaki.tv's servers, which doesn't bode particularly well.

One strength of the Wuaki.tv store is that it clearly marks titles that will soon be unavailable for rental. There's a dedicated section called 'last chance' so you can grab a last-minute rental of that film you've been meaning to see before it disappears.

The Android app lets you stream rented and purchased titles in HD. You can also download your purchased content to watch offline; this feature is only available on a small number of devices, but does include some big hitters such as the Tesco Hudl 2 and Samsung's and Sony's flagship smartphones. The full list can be found at [tinyurl.com/wuakiofflineandroid](http://tinyurl.com/wuakiofflineandroid). If your device isn't on the list, you can attempt to sign up to Wuaki.tv's beta programme to get yourself a version of the app that allows offline watching. The Android app is well laid out and it's easy to browse films by genre and director. The only frustration is that you're not shown the HD price of a purchase until you've tapped the Buy button and entered

your payment information. Until that point, you can only see the more attractive SD price.

There are no offline limitations on iOS. You can stream, download and watch content offline on all iOS devices, but you're limited to SD resolutions. You don't have access to the Wuaki.tv store from the app, though, so you'll need to make your purchases in a browser.

Games console access is limited to the Xbox 360 and Xbox One, with PlayStation users currently left out in the cold. Both Xbox apps let you stream content in 720p, and for some reason the Xbox One version includes four achievements that will earn you zero points towards your GamerScore.

Wuaki.tv and Amazon Instant Video have the largest Smart TV presence of the services we've seen. You'll find a Wuaki.tv app either preinstalled or available on Panasonic, LG, Sony and Samsung app stores. These apps all allow you to browse, rent, buy and stream content in HD. You'll also find Wuaki.tv on your EE TV box. Wuaki.tv is also compatible with Apple AirPlay and Google Cast, so you can watch it on your Apple TV or Google Chromecast via your tablet or smartphone.

Wuaki.tv has made a huge push in the UK in the past couple of years, but a modest library and maximum 720p-quality video means it doesn't offer anything you can't find elsewhere at the same price. Its library is at least well laid out and if you're an EE subscriber, it's the only place to get HD rentals of new films for £1, which is a huge selling point. If you're not with EE, though, you can find better-quality content and a larger range from iTunes and Google Play.

**BEST FOR** EE customers



## SAINSBURY'S Entertainment On Demand



movies.sainsburysentertainment.co.uk

HD film (rent/buy): £4.49/£13.99

SD film (rent/buy): £3.49/£9.99

### VERDICT

Sainsbury's has a thin collection of content, but some decent special offers mean it's worth the occasional look

**SAINSBURY'S DOESN'T MAKE** a huge deal about its digital film and TV rental service but, while the supermarket chain may not shout from the hills about it, it's well worth a look if you're searching for a bargain.

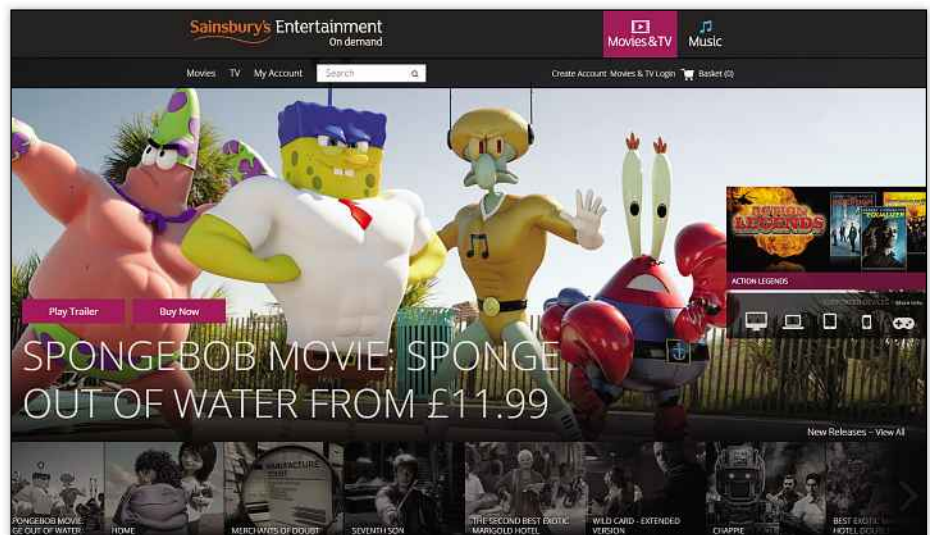
You may have come across Entertainment On Demand through in-store film rental voucher giveaways, or you may have received a free film rental by dint of subscribing to the Mobile by Sainsbury's phone network or a £25 voucher for subscribing to the Anytime Delivery online shopping service. Those who bought the £79 Linx tablet from Sainsbury's will have had the Entertainment On Demand Windows 8.1 app pre-installed, too.

Content is available in HD with stereo sound. Sainsbury's doesn't say which content, if any, is delivered in 1080p. The service is powered by Rovi, which develops the DivX codec that can stream at 1080p quality.

### CONTENT

From the off, it's clear that Sainsbury's Entertainment isn't going to break into the mainstream; it launched in 2013 with just a few hundred films, and the catalogue doesn't seem to have grown much. The TV selection is even thinner; try to find programmes aired in 2015 and you'll draw a blank. The most recent TV episodes you'll find are from 2014.

There are a few high-profile titles, including the complete *Breaking Bad* collection and *Mad Men*, although only the first two seasons of the latter are available. The upshot of this is



that most of the TV programmes are cheap, but when you can buy the complete final season of *Breaking Bad* for a little more on iTunes and get several extra features to boot, Sainsbury's deals don't seem that attractive.

There are, however, some bargains to be found in the films section. If you're willing to watch in SD, you can rent (at the time of writing) *12 Years a Slave*, *Django Unchained* and *Ted* for 99p each. There are new releases, too, including digital pre-releases of big films such as *Home* and *Chappie*. You'll pay the going rate for an HD film: £4.49 to rent for 30 days (to finish watching within 48 hours once you've started) and £13.99 to buy.

If you're not sure what you're after, Sainsbury's Entertainment's filter functions are very useful. You can filter films by genre, age rating, year and Rotten Tomatoes score. You can also search by actor, so if you have a hankering for a particular star, you can find their latest films as well as a few older ones that Sainsbury's has in its library.

Sainsbury's doesn't detail the resolution of its HD content, but on a full-screen HD monitor it looks slightly pixelated, so we're willing to bet it's 720p. No English subtitles are available on any videos, so Sainsbury's Entertainment should be avoided if you're hard of hearing; in April Sainsbury's said it was hoping to add these in "the near future".

### PLATFORMS

Sainsbury's Entertainment is available on a reasonable range of devices, so you'll probably be able to play Sainsbury's content on your TV, smartphone or tablet.

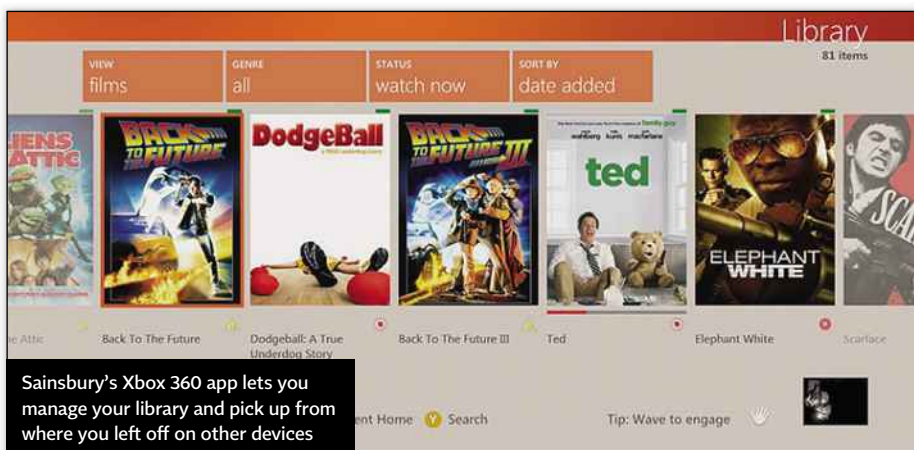
iOS, Android and Windows 8.1 devices get a similar offering in the form of a Sainsbury's Films & TV app. You can stream and download purchased items in 720p, and browse and buy from the store on the Android and Windows apps. However, once you download a rented video, you won't be able to watch or download it from anywhere else; the device to which you downloaded it is the only one allowed to play it back. If you want to switch from device to device, stick to streaming.

You'll also find Sainsbury's Entertainment on the Xbox 360. You can't download videos to watch offline, but you can at least watch in 720p HD. If you don't have an Xbox 360, you can watch on your TV either by casting from an Android tablet to a Chromecast dongle, or by sending your content to your Apple TV from an iOS device or any computer running iTunes via AirPlay. There's also a Roku app.

With such a wide range of devices available, the one-device download policy is all the more irritating, particularly for those who, for example, like to start watching a film on the way home from work on their tablet, and then switch to the bigger screen on their PC, Xbox or Roku when they get home. Sainsbury's Entertainment isn't particularly flexible in this regard, which is a shame.

There's no hiding from the fact that Sainsbury's Entertainment On Demand is a compromised experience. It ticks the boxes for having the latest films, and you can watch it on just about any screen you own. However, a small content selection and obtuse restrictions means its appeal is severely limited. Its various special offers and deals mean it's worth a visit from time to time, and if you collect Nectar points, it's as good a place as any to watch a new film for the same price as any of its much bigger rivals.

**BEST FOR** Sainsbury's shoppers and deal spotters



## SKY Store



www.skystore.com

HD film (rent/buy): No/£13.99 + DVD

SD film (rent/buy): £4.49/No

### VERDICT

With rentals limited to SD, no Full HD content and a fairly small library, Sky Store is redeemed only by its free DVD offer

**SKY'S PAY-PER-VIEW** film service is called Sky Store. This shouldn't be mistaken for the Sky Shop, where you buy TV and broadband packages, and is also entirely separate from Sky's NowTV subscription service, and it isn't part of Sky Films, either. What's more, it has no connection to Sky On Demand, which is a TV streaming service for Sky+HD subscribers.

### CONTENT

Sky Store is only for films, and there are no TV programmes available. Sky claims there are "more than 1,200" titles available, which is a fairly paltry selection. Still, we found all the latest releases on Sky Store, so if you're only after films you missed in the cinema recently, you'll probably find what you're looking for.

If you only want to rent a film, Sky Store is to be avoided. Rentals are only available in SD, but are priced at the same level as HD rentals on other services: £4.49. By comparison, most services charge £3.49 for an SD film rental, so Sky's offering is simply not competitive. If for some reason you choose to rent something, you have 30 days to start watching and 48 hours to finish once you press 'play'.

The service has one redeeming feature that physical media enthusiasts will love, and it's something that's unique to Sky Store. If you buy a film to keep from Sky Store (typically £13.99 for a new film), you'll also be sent a copy on DVD. This means you can have a physical representation of your digital



library. It's a shame it's only DVD quality; Blu-ray would be preferable, especially as you've already bought the film digitally in HD. However, the DVD would either make a low-cost gift or a way to show off your extensive film collection to your friends.

There are other drawbacks to the digital portion of the service. There are no subtitles, for example; a fact that Sky doesn't acknowledge in its FAQ section. You get 5.1 surround sound, but HD content is all 720p and not Full HD. The only exception is when

drawback if you want to rent a film to watch on your laptop on a flight but don't want to pay £13.99 to buy it outright.

Things are even worse for Mac users, who are limited to SD content only. Mac owners will be much better off with iTunes. The same is pretty much true for iOS owners, although the iOS app does at least have the saving grace of 720p streaming and downloads.

Android users also get 720p streaming and downloads, but you can't buy films from within the app, so you'll have to buy or rent

## There's 5.1 surround sound but no subtitles, and HD content is all 720p and not Full HD

you watch a rental on your Sky+ box, at which point you get a 1080i file, which still isn't as sharp as 1080p HD.

The library is fairly well laid out, with a menu breaking the catalogue down into genres. There's also a section for the latest releases, and one for British films. The 99p rental section is akin to a bargain bin at a supermarket, full of films you probably don't want to watch. There's also a Deal Of the Week, which has some reasonably attractive £5.99 digital HD + DVD offers, including *Turbo*, *Psycho* and *Les Misérables*.

### PLATFORMS

As with most video-streaming services, you can access your Sky Store library from a web interface. You can watch purchased 720p HD video on a Windows PC from a web browser, although you won't be able to watch in Chrome because Sky Store uses a Microsoft Silverlight-based player that Chrome doesn't support. If you don't want to use another browser, you can download the Sky Store application for Windows. This program, as well as allowing you to stream content, lets you download films you've bought. You can't download rented films, however, which is a big

drawback if you want to rent a film to watch on your laptop on a flight but don't want to pay £13.99 to buy it outright.

The only caveat with downloading your library is that you must occasionally connect your device to the internet so Sky can validate your video licences. Sky doesn't specify how often you'll need to do this, but it may become a problem if you're spending a while somewhere without Wi-Fi.

Unusually, you'll find a Sky Store player on your YouView box, which is a handy addition if you have no other means to rent films on your TV. However, there are cheap ways of getting access to other streaming services, such as with a Chromecast or Roku. If you have a Roku, you can play your purchased Sky Store content in 720p. The same applies to the Sky-owned NowTV box.

Sky Store feels a little bit detached from Sky's mighty empire, hosting a fairly small library of films and not catering at all well to the rental market. The gimmick of getting a DVD copy of every digital purchase might appeal to some, but in the hotly competitive world of pay-per-view, we expect better from the masters of paid-for UK TV content.

**BEST FOR** DVD collectors





## SONY PlayStation Video



www.playstationnetwork.com/video

HD film (rent/buy): £4.49/£11.99

SD film (rent/buy): £3.49/£9.99

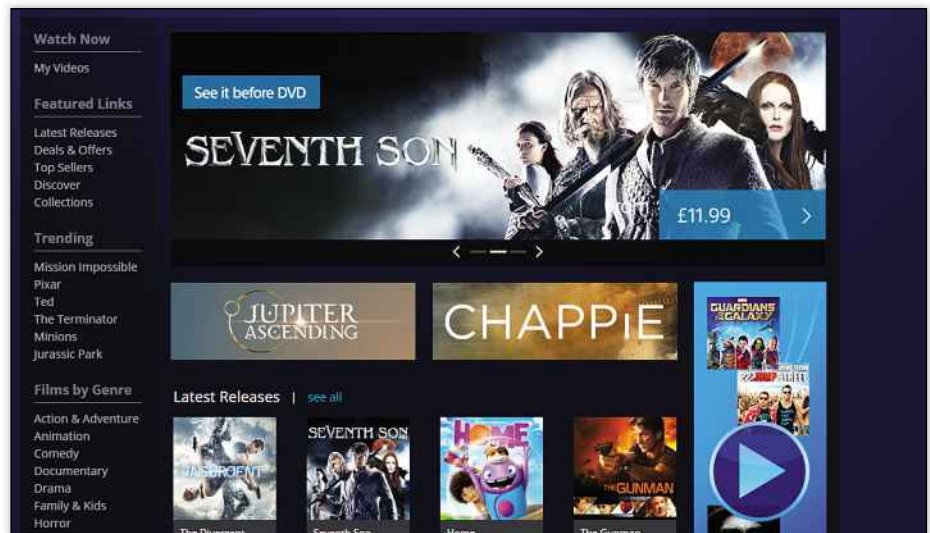
### VERDICT

Full HD streaming with 5.1 audio, but high-quality content is heavily biased towards Sony products

**THE PLAYSTATION TV** and film rental services first appeared in 2009, going through several rebrandings before re-emerging as PlayStation Video earlier this year. The service offers a wide range of video content but is unsurprisingly focused on Sony-made devices such as PlayStation consoles, Bravia TVs and Xperia smartphones and tablets.

The easiest place to buy and rent content is via the web store, which hosts new films from the big studios as well as popular series such as *Game of Thrones*. Season passes are available for TV shows, so you can pay for a whole series before it has aired and access each episode as soon as it becomes available. TV programmes are available in SD and HD, with a new TV series in HD typically priced at £22.99. New films, meanwhile, cost £4.49 in HD to rent and £11.99 to buy. Rentals last 30 days, and once you've started watching you have to finish within 48 hours.

The store is well laid out, with information available about each film, including certificate, cast, director and running time. You're also given technical information on audio quality, file size and whether subtitles are available. Films are available with up to 7.1 surround sound, but all the titles we found were available in 5.1 instead. There are only subtitles for non-English language films, which is a mark against the service. Special offers are clearly marked, with a 99p rentals section full of B-movies, as well as more desirable films such as *Rango* available to buy in HD for £7.99.



If you download a rental to a device, such as your PC or PlayStation, you won't be able to download it anywhere else and will only be able to watch it on that device. If you stream your progress will be remembered, so if you switch to another device, you'll pick up where you left off. There are some devices that aren't compatible with this feature, however, such as the PSP, Vita, PlayStation TV, 2012 and earlier Sony TVs and Blu-ray players, and the Windows-based Media Go app.

### PLATFORMS

Working out which devices are HD-compatible is complicated in the world of Sony, and

up to 900p, which is halfway between 1080p and 720p, and can also download content in Full HD and, where available, 3D. PS4 users don't get 3D, but can stream and download at Full HD resolutions. PlayStation TV, PSP and PS Vita users are all limited to SD content.

You also get Full HD on Sony Bravia Smart TVs, but you're only allowed to stream rather than download and can only watch rentals, not titles you've bought. It's a rather strange omission, so stick to renting content if you want to use your Smart TV with the service.

If you own a Sony Xperia smartphone or tablet, the Videos app will grant you access to the PlayStation Video store, and also lets you

## The best place to watch content is on your PS3 or PS4, with all other devices having to suffer a compromise

finding a full list is difficult. Handily, buried away in the FAQ is a table that breaks down the features of the service on each device; it can be found at [tinyurl.com/psvideobreakdown](http://tinyurl.com/psvideobreakdown).

In short, the best place to watch your rented and purchased content is on your PS3 or PS4, with all other devices having to suffer a compromise. PS3 users can stream video at

stream and download content from your library. You're limited to SD resolutions, though, even if your handset has an HD display. This is disappointing in an age of smartphones with HD resolutions and above.

Other Android devices, along with Apple iOS handhelds and Windows phones, aren't granted access to the PlayStation Video store. There's also no Roku app and no way to send your content to a Chromecast.

You shouldn't bother trying to watch on your PC or Mac, either, unless you're a fan of SD. You can stream SD video in your browser on both platforms, and the Media Go app for Windows also lets you download titles but, again, only in SD resolution.

PlayStation Video has some of the highest-quality content available, but the best quality is limited to the PS4 and, to a lesser extent, PS3. If you're a PS3 or PS4 owner, you could easily never rent anything from anyone else, provided you only want to watch on your console. The service isn't flexible enough to be your go-to film rental service, though, with a lack of apps on non-Sony devices and SD quality on the web limiting its appeal.



**BEST FOR** PlayStation and Sony TV owners ➔

# TALKTALK Blinkbox

**COMPUTER SHOPPER** ★★★★★

RECOMMENDED [www.blinkbox.com](http://www.blinkbox.com)

HD film (rent/buy): £4.49/£13.99

SD film (rent/buy): £3.49/£9.99

## VERDICT

Blinkbox offers 720p streaming on a huge variety of devices, but a small library and no Full HD content limit its appeal

**BLINKBOX WAS BOUGHT** by Tesco in 2011 as part of a move into digital content that also saw the supermarket giant try to woo consumers with its Hudl tablets. However, unable to fit Blinkbox into its overarching strategy, Tesco sold the video portion of Blinkbox to TalkTalk at the beginning of 2015.

TalkTalk says Blinkbox will be integrated into its other products, but what that means remains to be seen. For now, though, Blinkbox remains available to non-TalkTalk customers.

## CONTENT

Blinkbox hosts over 6,000 films and 960 TV series. Its library is utterly dwarfed by the likes of Amazon and Apple, but you won't miss out on the latest films from the big studios.

As far as TV goes, all five seasons of *Game of Thrones* are present and correct, alongside *The Walking Dead*, *Mad Men*, *Modern Family* and classics such as *The X-Files*.

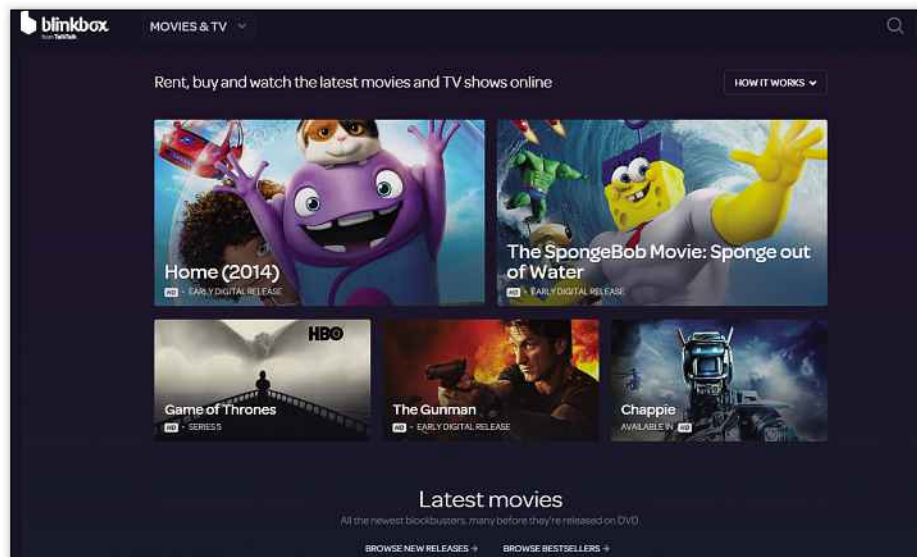
Blinkbox's pricing is in line with its rivals, with a new HD film costing £4.49 to rent and £13.99 to buy, a new HD TV episode costing £2.49 and a complete series £22.99. When you first sign up and deposit £1, Blinkbox gives you another £3.49 of credit, meaning you can immediately rent an HD film at no extra cost.

Blinkbox curates its catalogue into collections, which act as a way to focus your decision-making when looking for the next series to binge on or film to watch. The collections range from actors and directors to production companies and film series as well as genre-specific groupings; you'll find sets including the Jason Statham Collection, *Fast & Furious*, HBO Drama and The Comedy Collection. You can see which films are about to become available at [www.blinkbox.com/movies/coming-soon](http://www.blinkbox.com/movies/coming-soon).

When you click a film or TV show, you're also given alternative options similar to the content you selected, so you're never at a loss what to watch. Click any of the cast listed, and you'll be taken to a search page where you'll find all their other work hosted on Blinkbox.

There are also plenty of special offers, which are clearly marked and sometimes pretty generous. We found an HD copy of *Interstellar* for £8.99 instead of £13.99; a stellar deal indeed.

When you rent a film, you have 30 days to start watching, and 48 hours to finish once you hit 'play' for the first time. Most films and



TV programmes are available in 720p format (depending on your device and internet speed) with stereo sound. There's no Dolby 5.1 audio and no 1080p option available for any content. If you have a high-end home cinema system, Blinkbox won't do it justice. There are also no subtitles for the hard of hearing.

## PLATFORMS

Blinkbox is available for a wide variety of devices, including smartphones, tablets and TVs. There aren't too many irritating limitations here, with Blinkbox remaining remarkably consistent across the full spectrum of media consumption devices.

You can stream content from a web browser on both Windows and Mac PCs. Safari, Firefox and Internet Explorer all require Microsoft Silverlight, while Google Chrome users get an HTML5 player, which Blinkbox says requires a little more bandwidth than the Silverlight player. For Windows 8.1 and Windows 10 users, there's an app available in the Windows Store. This lets you download

can't sell items from within the app, so you'll need to buy items in your web browser before playing them in the app. Even Windows Phone 8.1 gets in on the act, with a great app that lets you stream content in 720p, though there's currently no option to watch offline.

Content can also be streamed to your TV in 720p using a Google Chromecast dongle, via Chrome in Mac and Windows, as well as from iOS and Android devices, which is handy if you don't have a dedicated set-top box.

The only limitation with downloaded content is that you must check in with Blinkbox's DRM servers every 30 days on a UK internet connection on whichever device you plan on using to watch the content. If you don't do this, downloads on that device – even those you bought to keep – stop playing.

You should be able to stop watching on one device and continue on another where you left off, although in our experience this wasn't always reliable, with multiple devices starting from the same point even though we'd watched several minutes of a

## There are plenty of special offers, which are clearly marked and sometimes pretty generous

TV episodes and films to your Windows PC, laptop or tablet, which is extremely useful.

The Blinkbox app for Android is fully featured, and includes 720p streaming, downloads and the ability to buy and rent items from the store. It has a clean user interface and is easy to use. There are a few Android version-specific issues, though – devices running Android 4 can't download items to an SD card, while tablets running 4.4.3, 4.4.4 and 5.0.0 don't support downloads due to incompatibility issues. We tested the service on a Nexus 9 running Android 5.1 and had no problems, however.

Apple iOS devices are well supported, with the iPhone getting SD streams and downloads and the iPad granted access to HD streams and downloads. Apple policy means Blinkbox

programme. Furthermore, your progress on downloaded videos is not kept in sync, so you might find yourself scrolling through your videos trying to work out where you were.

We're impressed with Blinkbox. It has a great user interface and is compatible with a huge number of devices with some very well-made apps. Its watch offline feature on Windows 8.1 and 10 is a huge boon, too. It's a shame that you only get 720p playback at best, and the lack of 5.1 surround sound and subtitles will put some buyers off. If its device support suits you better than iTunes or Google Play, and you're happy with 720p, it's well worth a look.

**BEST FOR** Windows 10 PC, tablet and phone users

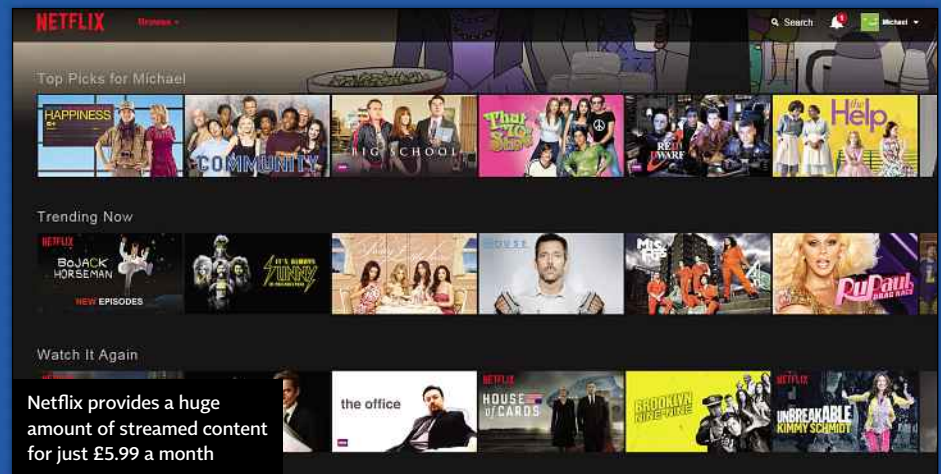


# What about Netflix?

You'll have noticed that we haven't reviewed one of the giants of online streaming: Netflix. This is because this group test was focused on replacements for your local video shop, where you can rent or buy films for a one-off fee rather than having to take out a subscription. However, although the service doesn't offer rentals or outright purchases of TV programmes or films, it gives you a large amount of streamed content for a very reasonable £5.99 a month.

While Netflix in the UK was arguably given a massive boost by its deal to show the final season of *Breaking Bad* the day after it aired in the US back in 2013, it's far more than just a place to watch US network TV. In 2015, Netflix is expecting to add 320 hours of original content to its service, with programmes including *House of Cards*, *Orange is the New Black* and *Daredevil* all causing a stir among TV fans and critics alike. It's also saved some TV series from the abyss, commissioning shows that were otherwise going to be cancelled. These include *Arrested Development*, *The Killing* and *Trailer Park Boys*. There's also a dizzying array of stand-up content and one-off documentaries, too.

Netflix is a service that was born on the web and has therefore had a bit of a head start on its rivals, including HBO in the US and Sky here in the UK. Even Amazon Instant Video is playing catchup. Netflix's CEO, Reed Hastings, left no room for doubt when he told the *New York Times* where he



## Netflix is a service that was born on the web and has therefore had a bit of a head start on its rivals

thinks the industry is going: "We've had 80 years of linear TV, and it's been amazing, and in its day the fax machine was amazing. The next 20 years will be a transformation from linear TV to internet TV."

Our table on pages 90-91 shows you which online film purchase and rental services support which devices. While many

have an impressive presence, none of them even come close to Netflix, which would happily add an app to your fridge if it had an internet connection. You even get televisions with a dedicated Netflix button on their remote controls, such is the brand's push for your wallet and time.

If you're not a movie buff but you want a cheap form of entertainment, Netflix's constantly evolving back catalogue and ever-expanding original content roster could legitimately make it the only video service you ever bother using. To keep an eye on what's coming up and what's about to be removed from the library, check [uk.newonnetflix.info](http://uk.newonnetflix.info), which has an exhaustive list of all the TV programmes and films hosted by the service.

# Shopping around

If you're fairly flexible about which service you choose for your content, then it pays to shop around. As you can see from the 'Big-ticket prices' table on pages 90-91, you can spend quite a bit less on some titles if you don't opt for the first rental service you come across. Our table only compares nine TV series and films across the nine services, so is hardly exhaustive, but it will still give you an idea of how much prices can vary across different pay-per-view services. In our calculations we have always used rental prices as the cheapest, if available, as we

feel most people would rather rent a film where possible than buy it outright.

Of the titles we chose to compare, only three services hosted all nine: Amazon, iTunes and Google Play. Of those three, Google Play was the cheapest by £7.90, due to offering *Avatar* as a rental, where the other two comprehensive services would only allow you to buy it outright. Google Play was also at least £2 cheaper for *Star Wars: The Empire Strikes Back*.

Google Play was cheapest, or joint-cheapest, for six of the nine titles, while it

was 50p more expensive for *Game of Thrones* and £1.50 more for *Community*.

If you bought or rented all nine titles at their cheapest on any service, you'd spend a total of £97.91, £3 less than buying everything from Google and £10.94 less than from iTunes. Meanwhile, the average price of all nine rentals or purchases came to £111.05, which is a fair whack. Of course, other variables such as which devices you have and which resolution you want will have an impact, so simply going for the cheapest option won't always be viable.



	AMAZON	RECOMMENDED APPLE	RECOMMENDED GOOGLE	MICROSOFT
	Instant Video	iTunes	Play Movies & TV	Films & TV
	★★★★☆	★★★★★	★★★★★	★★★★☆
<b>Pricing</b>				
HD film (rent/buy)	£4.49/£13.99	£4.49/£13.99	£4.49/£13.99	£4.95/£13.99
SD film (rent/buy)	£3.49/£9.99	£3.49/£9.99	£3.49/£9.99	No/£9.99
HD TV series (buy only)	£22.99	£23.99	£23.49	£23.99
SD TV series (buy only)	£16.99	£17.99	£17.49	£17.99
<b>Content</b>				
Rental period	30 days	30 days	30 days	14 days
Time to finish watching	24 hours	48 hours	48 hours	24 hours
Subtitles	Yes	Yes	Yes	Yes
5.1 surround sound	Yes	Yes	Yes (not on YouTube)	Yes
<b>Platform details</b>				
Web/PC/Mac	Web: Windows and Mac 720p TV streaming. Windows 720p films, Mac SD films streaming	Application: Windows and Mac 1080p download	Web: Windows up to 1080p streaming, Mac 1080p on laptops, SD on desktops streaming	Web: Windows and Mac 720p streaming. Windows 8.1 and 10 app: 720p streaming and download
Roku	No	No	1080p	No
Amazon Fire TV	1080p	No	No	No
Amazon Kindle Fire	1080p	No	No	No
Games consoles	PS3, PS4, Xbox 360, Xbox One, Wii U: 720p streaming. Wii: SD streaming	No	PS3, PS4, Xbox 360, Xbox One YouTube application: 1080p streaming	Xbox 360, Xbox One: 1080p streaming and download
Smart TV/box manufacturer support	Sony, Samsung, LG, Panasonic	No	Via YouTube on Smart TVs made after 2013	No
Smart TV/box quality	Up to UHD	N/A	1080p	N/A
iOS	SD streaming and downloads	4th gen iPod Touch and iPhone, original iPad and above: 1080p downloads	SD streaming and downloads	No
Apple TV/AirPlay	No/Yes (720p)	Yes (1080p)/Yes (1080p)	No/Yes (1080p via YouTube for iOS)	No/No
Android	SD streaming	No	1080p streaming and downloads	No
Windows Phone	No	No	No	SD streaming and downloads
Chromecast	No	No	1080p streaming	No
UltraViolet support	No	No	No	No
Details	www.amazon.co.uk/instantvideo	www.apple.com/uk/itunes/video	play.google.com/store/movies	video.xbox.com

## BIG-TICKET PRICES

	AMAZON Instant Video	APPLE iTunes	GOOGLE Play Movies & TV	MICROSOFT Films & TV
Game of Thrones Season 5	£22.99	£23.99	£23.49	£23.99
Community Season 6	£19.99	£19.99	£21.49	£20.99
Mad Men Season 7 Part 2	£16.99	£17.43	£16.99	£16.49
Star Wars: The Empire Strikes Back	£11.99	£13.99	£9.99	£13.99
Terminator 2	£6.99	£3.49	£3.49	£3.49
Toy Story	£13.99	£13.99	£13.99	£13.99
Rain Man	£7.99	£7.99	£3.49	N/A
Avatar	£9.99	£3.49	£3.49	£3.49
American Sniper	£4.49	£4.49	£4.49	£4.95
<b>TOTAL COST</b>	<b>£115.41</b>	<b>£108.85</b>	<b>£100.91</b>	<b>N/A</b>
Number of cheapest titles	5	5	6	3
Number of missing titles	0	0	0	1



	RECOMMENDED
RAKUTEN	TALKTALK
Wuaki.tv	Blinkbox
★★★★☆	★★★★☆
£4.49/13.99	£4.49/£13.99
£3.49/£9.99	£3.49/£9.99
£22.99	£22.99
£16.99	£16.99
48 hours	30 days
48 hours	48 hours
No	No
No	No
Web: Windows and Mac SD streaming. Windows 8.1 app: 720p streaming	Web: Windows and Mac 720p streaming. Windows 8.1 and 10 app: 720p download
No	No
No	No
No	No
Xbox 360, Xbox One: 720p streaming	PS3: SD streaming. Xbox 360, Xbox One: 720p streaming
Samsung, Sony, Panasonic, LG, EE	Samsung, LG
720p	720p
SD streaming and downloads	SD on iPhone, 720p on iPad streaming and downloads
No/Yes (720p)	No/No
SD streaming and downloads	Android 4+: SD and 720p streaming and downloads
No	720p streaming
720p streaming	720p streaming
Yes	Yes
uk.wuaki.tv	www.blinkbox.com

RAKUTEN	SAINSBURY'S	SKY	SONY	TALKTALK
Wuaki.tv	Entertainment On Demand	Store	PlayStation Video	Blinkbox
£22.99	N/A	N/A	£22.99	£22.99
N/A	N/A	N/A	£20.99	N/A
N/A	N/A	N/A	£17.99	N/A
£13.99	£13.99	£13.99	£11.99	£13.99
£2.99	N/A	N/A	£3.49	£3.49
£13.99	£13.99	£13.99	£13.99	£13.99
N/A	N/A	N/A	N/A	N/A
£9.99	£3.49	£13.99	£3.49	£9.99
£4.49	£4.49	£13.99	£4.49	£4.49
N/A	N/A	N/A	N/A	N/A
5	3	1	5	3
3	5	2 (Not including TV programmes)	1	3

Prices correct at time of going to press

*The ultimate guide to...*

# Windows

It's the biggest Microsoft launch in years, and the first Windows version to be given away for free. But what's new in Windows 10, and why should you upgrade? Our ultimate guide reveals all

**W**indows 10 is a big deal for Microsoft. The company is so keen to get everyone running its latest operating system it's giving it away for free. It's also been referred to as the 'last version' of Windows. From now on, instead of each new version arriving with a big splash, updates will be continuous, just as they are with your web browser; no-one talks about running Chrome 43 – they just say Chrome.

It's also the operating system that Microsoft hopes will make people love Windows again, after Windows 8's interface flabbergasted and infuriated those coming from older Windows versions. It's designed to work properly across desktop PCs, laptops, touchscreen laptops, tablets, phones and even the Xbox, providing a consistent experience and, phones and Xbox aside, the same applications.

Microsoft's latest operating system has many exciting new features, which we've explored in

detail. If you've already taken the plunge and installed Windows 10, this guide will help you become an expert, and if you've yet to decide, it will show you why this is one free upgrade you won't want to miss.

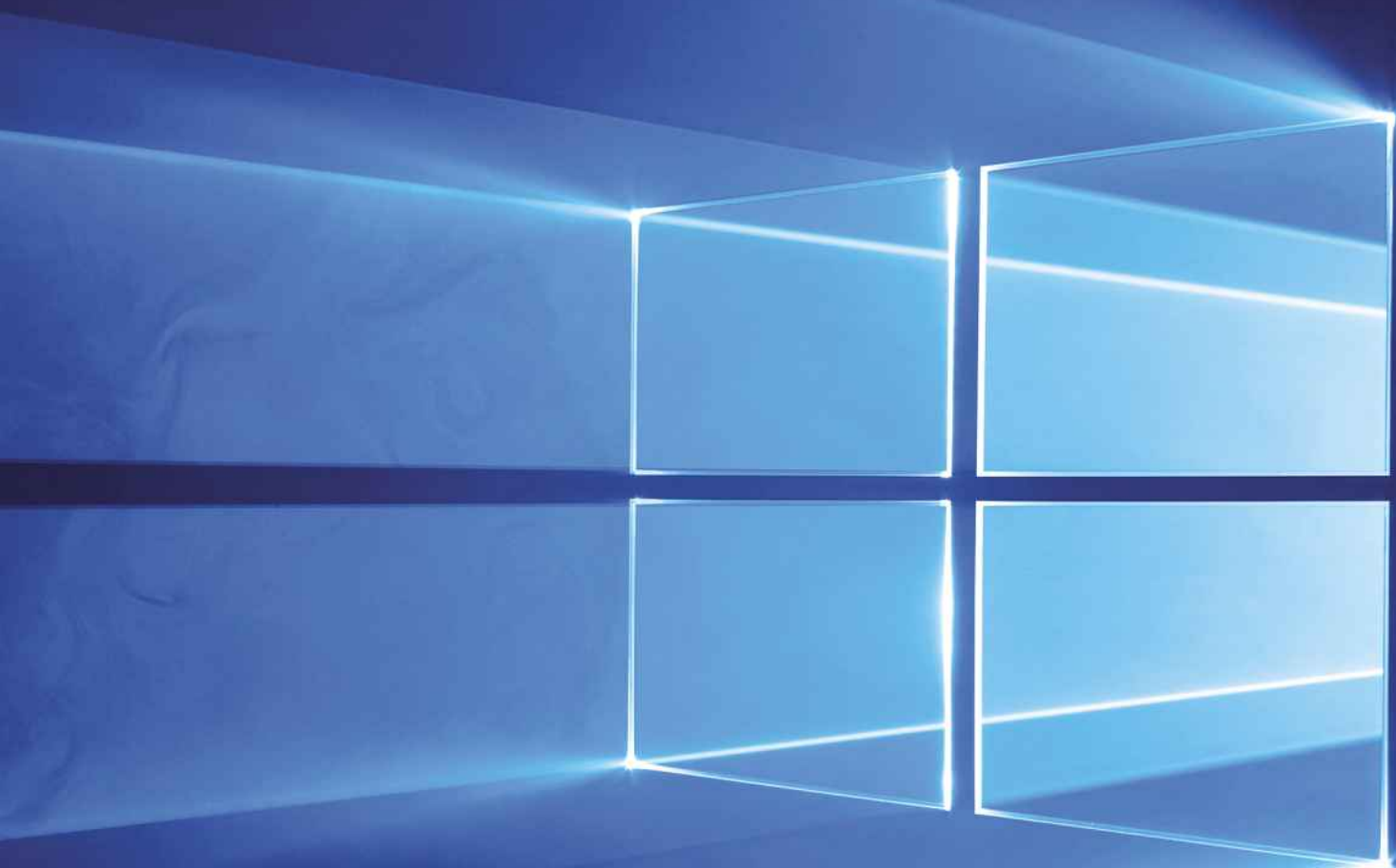
## **The new desktop**

It's well known that people didn't really get on with Windows 8's interface. For those coming from previous versions of Windows, it was just too much of a shock, from the replacement of the Start menu with the Start screen to the mystery of the Charms bar and the bizarre twin Settings menus. Windows 8 is a stable, fast operating system, but the interface, despite being designed for both tablets and PCs, didn't work brilliantly on either.

That has all changed in Windows 10. The new interface is designed to work properly with touchscreens as well as with a keyboard and mouse, and yes, it has a Start menu.



# OWS 10



## The Start menu

The biggest complaint about Windows 8 was the lack of a Start menu. The full-screen replacement may have worked well with touchscreens and had some useful features, such as Live Tiles to show you news headlines or weather information, but it made finding any installed programs needlessly difficult.

Microsoft eventually relented and added a Start button in Windows 8.1, but this was just a shortcut to open the Start screen, so was entirely pointless. There was such demand for a proper Start menu that several third-party companies made their own for Windows 8, such as the excellent Classic Shell.

In response, Microsoft has decided that Windows users can have a Start menu after all, and instead of inflicting a touchscreen interface on everyone, Windows 10 has a Start menu for PCs and laptops and a full-screen Start screen for tablets and touchscreens.

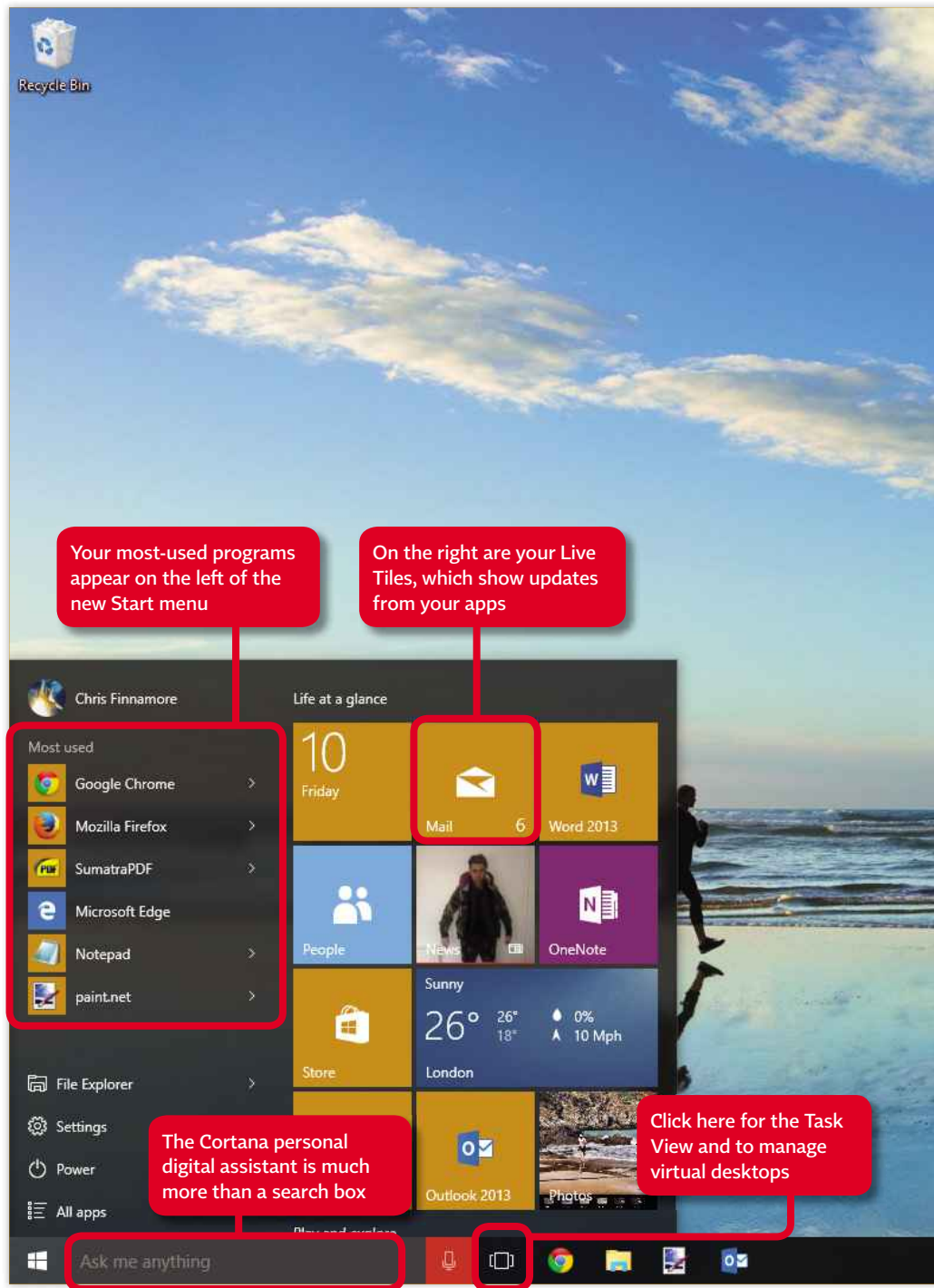
## Desktop PCs and laptops

Non-touchscreen computers by default have a Start menu. On one level, this will be familiar to Windows 7 users; on the left are your most-used programs, and shortcuts to the File Explorer and your PC's settings. As you'd expect, pressing 'All apps' brings up all your applications, but these are arranged in a different way to how they were in Windows 7. Instead of a mix of application subcategories, such as 'Accessories' or 'System', and various other folders created by the applications themselves upon installation, Windows 10 simply has an alphabetical list of programs and program folders. The applications list is divided by letter, and you can jump quickly to a particular letter by clicking one of the letters to bring up an alphabet grid.

This is a much easier way of seeing what's installed than Windows 8's haphazard horizontal slew of programs, split into so-called 'Modern' full-screen apps and other categories. You can simply search for an application by pressing the Start button and typing; the list of matches will narrow down as you add letters. This was how we tended to run applications in Windows 7 and 8, and it's still the quickest way to run a program if you know it by name. Right-clicking an application gives you the option to pin it to the taskbar or to the right-hand side of the Start menu.

## Full-screen Start

At the right of the Start menu you'll find the Live Tiles you know and (possibly) love from Windows 8 and Windows Phone. These are split into 'Life at a glance', with Live Tiles for information resources such as the Weather and Calendar apps; and 'Play and explore', with Music and Video apps and Xbox. If you want more space for these, you can resize the Start menu by clicking and dragging the top or right-hand edges, just as you would a normal window. Dragging from the top lets you alter the height in smooth graduations, but dragging from the right only resizes the menu in set chunks.



If you want more Live Tile space, you can switch back to the Windows 8-style full-screen menu. Click Start, type "start screen", then select 'Use Start full screen'. This brings up the Start section of the Personalisation menu; just click the 'Use Start full screen' toggle to make things Windows 8-style. There have been some tweaks to the full-screen Start, too; click the three horizontal lines at the top-left (the 'hamburger' menu) to bring up your most-used applications, and the bulleted list icon at the bottom-left under the power button to see all your apps.

## Touchscreens and tablets

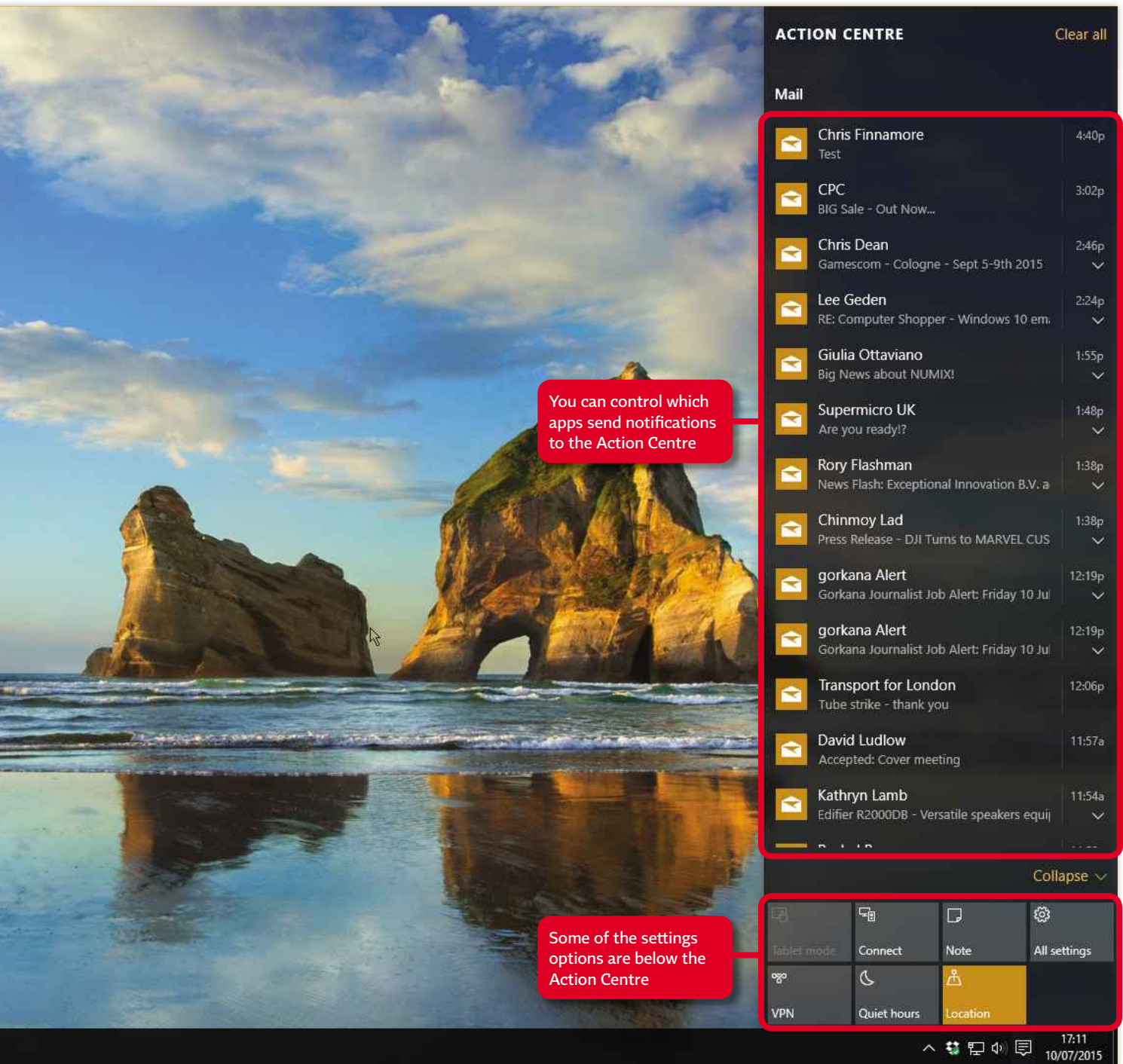
If you have a touchscreen, you can swipe in from the right to access the Action Center (more on that below) and select Tablet mode. This makes the Start menu go full screen and

changes the taskbar from one showing your running programs to a simplified version with only back and search icons and a task switcher. Applications will open full-screen in this view, but you can drag them to be next to each other, allowing for some multitasking. Dragging an app up to the top of the screen will make it full screen, and dragging it to the bottom will close it. If you want to access your desktop again, simply open the Action Center again and switch off Tablet mode.

## Continuum

Microsoft has designed Windows 10 to work particularly seamlessly with hybrid tablet/laptops, with what it calls its 'Continuum' feature. When a hybrid, such as the Surface 3, has a keyboard attached, it will default to the standard Windows 10 desktop. When you





remove the keyboard, it will automatically go into Tablet mode (you can also set it to pop up a confirmation window before it switches modes). We've seen this demonstrated by Microsoft on a Surface 3, but we're not sure how it will work on other hybrids, such as those where the keyboard folds back behind the screen to switch to tablet mode. Microsoft says this depends on whether the hybrid sends a signal to the operating system when you change its configuration. Nothing happened on our test Dell XPS 11 hybrid when we folded its keyboard into tablet mode, for example, but it's easy enough to swipe in from the right and select Tablet mode yourself.

### Action Centre

The Charms Bar from Windows 8, which no-one really understood, let alone used, has

gone. In its place is something more useful: the Action Centre. The concept will be familiar to anyone who's used a smartphone or tablet: it's a repository for app notifications at the top, with toggle switches for useful functions below. The notification area shows updates such as recent email messages, as well as system notifications, telling you when updates have been installed, for example. Right-clicking each of these notifications gives you the option to hide notifications from that particular app, or to open the Notification settings for some fine tuning.

The toggle switches cover functions such as switching in and out of Tablet mode or enabling or disabling wireless. You can also right-click a toggle switch to go straight to the relevant Settings menu. Windows 10 has all its settings in one place, with the majority

redesigned to suit Windows 10's look and feel. It's a great improvement over Windows 8's baffling split between Windows 7-style and Modern-style settings.

### Cortana

Cortana, Microsoft's personal digital assistant, is deeply tied in to Windows 10. This is a search engine and all-round information resource, which lives next to your Start menu. To see how Cortana works on Windows 10 computers, tablets and smartphones, see page 107.

### Virtual desktops

Next to Cortana is a tiny icon that looks like a rectangle behind a square. This is one of Windows 10's biggest new features: virtual desktops. For more information, see page 104. ➔

## Upgrade to Windows 10 for free

If you already have Windows 7 or 8, you can get Windows 10 for free. Here's how

**ALTHOUGH MICROSOFT IS** letting every Windows 7 and 8 user upgrade to Windows 10 for free, provided they register within one year of Windows 10's release on 29th July 2015, the upgrade system is unfortunately a little bit more complicated than you may have first thought. The main restriction is that the free upgrade from Windows 7 or 8 to Windows 10 is listed as being for "the life of the device".

after the upgrade. So, if you have a computer that shipped with Windows 7 or 8, it will have an OEM licence, which means the operating system is tied to that computer and can't be transferred to a new one. It also means you can't transfer the upgraded version of Windows 10 to a new computer, either.

If you bought a retail boxed version of Windows 7 or 8, things are different, as these can be transferred to a new computer. This means you can upgrade to Windows 10 and transfer the licence to a new PC. This is good news for anyone who wants to build a new computer using their existing retail licence of Windows and upgrade to Windows 10.

Before you claim your upgrade, you need to upgrade to the latest version of your current OS. This will be Windows 7 SP1 or Windows 8.1, both of which are available through Windows Update. Finally, check your PC is capable of running Windows 10 (see Step 2, below.)

the upgrade has finished, we'd recommend using Belarc Advisor from [www.belarc.com/free\\_download](http://www.belarc.com/free_download) to retrieve your new Windows 10 key, which you will need to perform a clean installation later. The current version of Belarc will list the key under 'Windows 8.1'.

### Boxed copies

If you're not eligible for the upgrade, or you want another copy of Windows 10, you'll need to buy a copy of the software. Windows 10 will be available as boxed software and should be available to buy as a download, too. These versions of Windows 10 will work in the same way as traditional boxed copies of previous versions of Windows, so you'll be able to install the OS on a computer of your choice, and reinstall it when you build a new model.



### Upgrade restrictions

The problem is that we don't know what this means, and Microsoft has muddied the waters by saying the lifetime will change depending on the device, estimating that it will be between two and four years. Whether that means that people who get the free upgrade will have to start paying for updates at some point outside this period, we don't know.

What we do know is that the licence type you have for Windows 7 or 8 stays the same

### Performing a clean install

Once you've upgraded a computer to Windows 10, you'll be able to perform a clean installation of the operating system, as Microsoft has made an ISO disc image of the operating system available for download. You can use our instructions on page 98 to turn this ISO file into a bootable DVD or USB flash drive. Windows 10 will activate automatically online, so you won't need to enter another licence key during installation. However, once

### FREE UPGRADES

Current version	Free upgrade to:
Windows 7 Starter	Windows 10 Home
Windows 7 Home Basic	Windows 10 Home
Windows 7 Home Premium	Windows 10 Home
Windows 7 Professional	Windows 10 Pro
Windows 7 Ultimate	Windows 10 Pro
Windows 8.1	Windows 10 Home
Windows 8.1 Pro	Windows 10 Pro

### RETAIL PRICES

Windows 10 Home	£100
Windows 10 Pro	£190

## Getting your upgrade

**1** First, run Windows Update from the Control Panel and make sure that your computer is up to date and running the latest service packs: you need Windows 7 SP1 and Windows 8.1 installed in order to upgrade to Windows 10.

**2** Once your Windows installation is fully updated, a small flag icon should appear in the Windows Notification area on the desktop. Click this to launch the Get Windows 10 app. To check your computer is capable of running the upgrade, click the Menu button (the three horizontal lines at the top-left of the screen) and click Check My PC. This will tell you if your computer is ready to upgrade: you'll need a 1GHz processor, 1GB of RAM (for 32-bit Windows) or 2GB RAM (for 64-bit Windows) and 16GB free disk space. You'll be told if any aspect of your PC is lacking, giving you a chance to upgrade (if possible) or clear some disk space. Any device or software incompatible with Windows 10 will be flagged, but we haven't run into any major problems when testing the new OS.

**3** Click the Menu button again and click 'Reserve your free upgrade'. Windows 10 will then be reserved for you. To check, relaunch the Get Windows 10 app, click the Menu button then click View confirmation. You'll be told when Windows 10 has downloaded; once it has, you can perform an in-place upgrade of your existing operating system. Once you've upgraded your computer, you can create installation media and perform a clean install (see page 98).





# Replacing missing features

Windows 10 is missing a few Windows 7 and 8 features. Here's how to get them back

**AS GOOD AS** it is being able to upgrade to Windows 10 for free, in the process you'll lose a number of features from versions 7 and 8. This is simply a case of Microsoft no longer wishing to support some of its older operating systems' features. Although it may not make a lot of difference to some people, for others it could be a real deal-breaker. Here we'll show you six features you could lose in the upgrade, and how to replace them. Here's a brief overview of what's missing.

WINDOWS 10 MISSING FEATURES	
Feature	Originally available
Windows Media Center	Windows 7, Windows 8 (optional upgrade)
DVD playback	Windows 7
Desktop gadgets	Windows 7
Hearts, Minesweeper and Solitaire	Windows 7
USB floppy drive support	Windows 7, Windows 8
Windows Live Essentials OneDrive	Windows 7, Windows 8

## Windows Media Center

Windows Media Center is one of the biggest features to bite the dust. Part of Windows 7 by default and available on Windows 8 as a paid-for upgrade, Media Center turned your computer into a fully fledged personal video recorder (PVR) and media playback system.

Microsoft's version was one of the best Media Center applications available, thanks to its slick interface and excellent PVR. If you're

running a Media Center PC our advice is simple: don't upgrade to Windows 10, as you'll just be creating hassle for yourself.

If you've upgraded to Windows 10 and want to turn your PC into a media centre, there are a couple of alternatives you could try: Kodi ([kodi.tv](http://kodi.tv)) or MediaPortal ([www.team-mediaportal.com](http://www.team-mediaportal.com)). Both are free and have similar features to Windows Media Center, but they're slightly rough around the edges and are best suited to hobbyists.

## DVD playback

Windows 8 didn't support DVD playback (unless you upgraded and installed Media Center), so the lack of support in Windows 10 will come as a shock only to Windows 7 users. Fortunately, this is an easy feature to replace. If you don't want to spend any money, VLC ([www.videolan.org](http://www.videolan.org)) is an excellent free player. If you want an application with a few more features and Blu-ray playback, you'll need



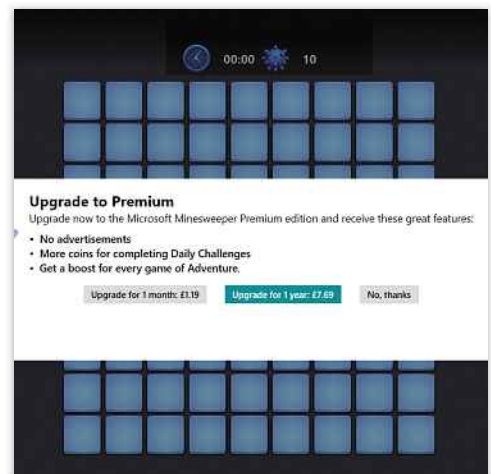
↑ VLC is a great application for playing DVDs, and it's completely free

commercial software such as PowerDVD 15 Pro (£60 inc VAT from [www.cyberlink.com](http://www.cyberlink.com)).

## Hearts, Minesweeper and Solitaire

Windows 7 had all these games built in, while Windows 8 users had to download them from the Microsoft Store. Under Windows 10, all these games are available, but it's up to you how you want to install or run them.

All Microsoft card games are now available through the Microsoft Solitaire Collection, which is a single app that's installed by default. Minesweeper is a slightly different story, as you have to download it from the Microsoft Store. There's a free version that's ad-supported, or you can pay £1.19 a month or £7.69 a year to remove the ads. In addition, the new version adds some new challenge modes. We're not big fans of the new version, as it looks ugly and is a whopping 195MB download. Instead, just download and install the free Minez Minesweeper clone ([windrealm.org/minesweeper](http://windrealm.org/minesweeper)).



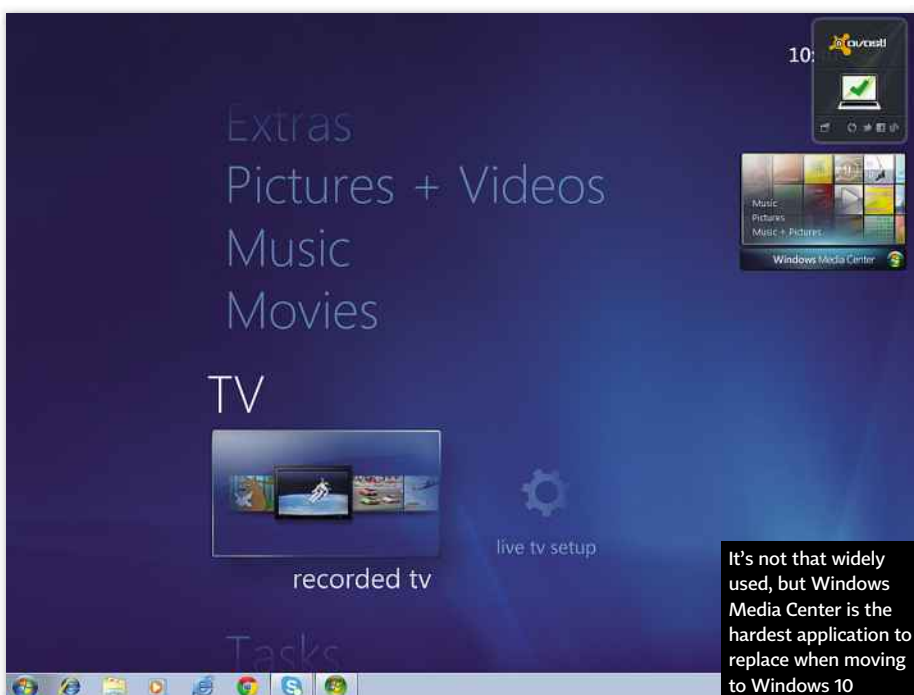
↑ If you want Minesweeper without adverts, you'll need to pay £7.69 a year for the privilege

## USB floppy drive support

If you're still using floppy drives, it's time to copy all your data off them and save your files to a hard disk, as Windows 10 won't support USB floppy drives. If you really need to use one, all is not lost: just download a driver from your floppy drive's manufacturer.

## Windows Live Essentials OneDrive

If you have Windows Live Essentials installed on Windows 7 or 8 and upgrade to Windows 10, the OneDrive App will be replaced by the OneDrive Inbox, which combines email and OneDrive storage. For everyone else, Windows 10 has a built-in default email app, and OneDrive file access is integrated into Windows Explorer, automatically synchronising any files you copy to the folder to your free cloud storage account.



## Create a Windows 10 install disk

To install Windows 10 from scratch you may need to create an install disk. Here's how

**WINDOWS 10 IS** available as a boxed product, and also on a USB flash drive, for those who want to buy it outright. Those entitled to a free upgrade from Windows 7 or 8 will be able to install Windows 10 from scratch after they have performed the initial upgrade (see page 96).

To help people do a clean installation of the new OS, Microsoft has made ISO disc images available for download from [microsoft.com/en-us/software-download/windows10](http://microsoft.com/en-us/software-download/windows10). If you're using Windows, you'll be redirected to download the Media Creation Tool. This will download the Windows ISO for you and create a USB install disk automatically; you just need to run the tool, select 'Create

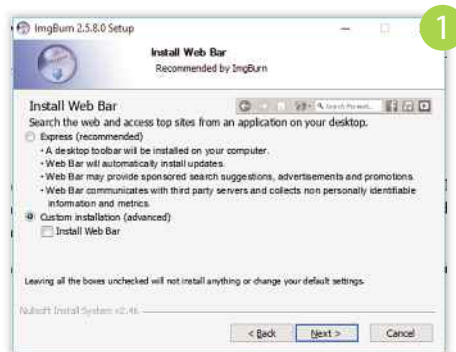
installation media for another PC', choose the version of Windows you're entitled to (see the table on page 96, and ignore the 'N' versions), and whether you need 32- or 64-bit. Once the process is complete the tool deletes the image file it downloads, which is no good if you want to use it for an install in the future. A better way is to use the Tool to download the image, by selecting the 'ISO file' option, then follow the steps below to create your installation media. You'll be able to install from a DVD on any computer with a DVD drive, and most computers made in the last 10 years or so will support booting from USB flash drives; USB installs are also faster than DVD.



### Creating an installation DVD

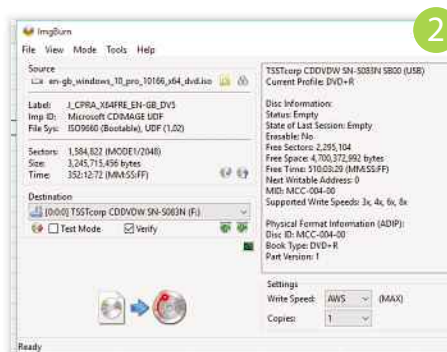
The only tricky part of creating an installation DVD is making sure you burn the Windows 10 disc image to your DVD as a bootable image rather than as a file. You can use any disc-burning program you like, and the steps will be broadly similar, but we've used the free ImgBurn application.

**1** Go to [www.imgburn.com](http://www.imgburn.com) and click Download in the menu at the top. Click the last Mirror link (Mirror 7 – Provided by ImgBurn), save the file to your hard disk and run it. Follow the steps to install the program, but make sure you deselect the advertising add-ons the setup program tries to install;



you'll need to select 'Custom installation (advanced)' to get rid of one of them.

**2** Run ImgBurn, and click 'Write image file to disk'. Click the icon of a folder with a



magnifying glass next to Source, and browse to the Windows 10 ISO you downloaded. Double-click the ISO file, put your blank DVD in the drive and click the large write icon at the bottom to create your DVD.

### Creating an installation USB flash drive

This is a bit more complicated than making a DVD, but the excellent Rufus application simplifies matters somewhat. Remember that you'll need at least a 4GB flash drive, and that any data already on the drive will be wiped during the process.

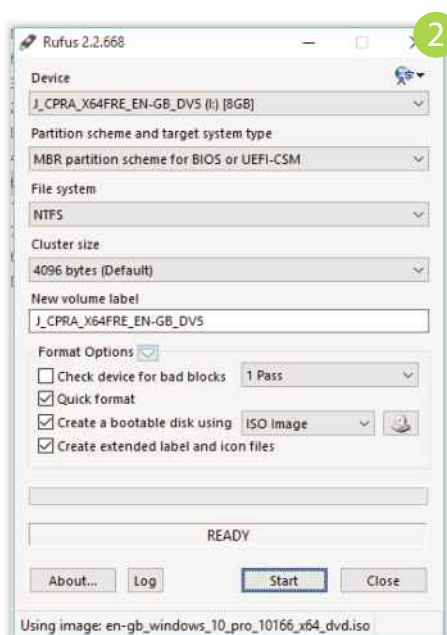
**1** Go to [rufus.akeo.ie](http://rufus.akeo.ie), and download the latest version (2.2 at the time of writing, about a third of the way down the page). Save it to your computer and run it. Plug in your flash drive, and it will appear at the top under Device. Rufus will show the USB stick's drive letter in brackets after the flash drive's name. Check in Computer/This PC that this is definitely the drive you want to use for your Windows 10 installer disk as it will be entirely and irretrievably wiped during the installation process.



**2** Under 'Partition scheme and target system type' select 'MBR partition scheme for BIOS or UEFI', and under File system select NTFS. Check that 'Quick format', 'Create a bootable disk using' and 'Create extended label and icon files' are selected, make sure 'ISO image' is selected in the drop-down next to 'Create a bootable disk using' and click the small icon that looks like a DVD drive with a disc above it.

Browse to the ISO file you downloaded earlier and double-click to select it, then click Start.

Read the warning about flash drive data destruction, then sit back and wait for your Windows 10 flash drive to be created, which will take around five minutes depending on the speed of the drive.





## How to...

# Install Windows 10

Our guide will make installing Windows 10 from scratch a painless process

**THE INSTALLATION PROCESS** for Windows 10 isn't much different to any other version. This guide is for those who want to install Windows 10 from scratch, wiping their hard disk in the process. If you're planning to upgrade from Windows 7 or 8, follow our upgrade guide on page 96.

You'll need a Windows 10 DVD or USB flash drive; you'll either have bought one or made your own from Microsoft's ISO download (see opposite). We've also assumed you've backed up all the files you need and have made a note of any settings and licence keys for applications you want to reinstall later; you'll need to follow the same procedure as for any operating system reinstallation, so if you're not confident doing this, you should perform an in-place upgrade of Windows 10 instead.

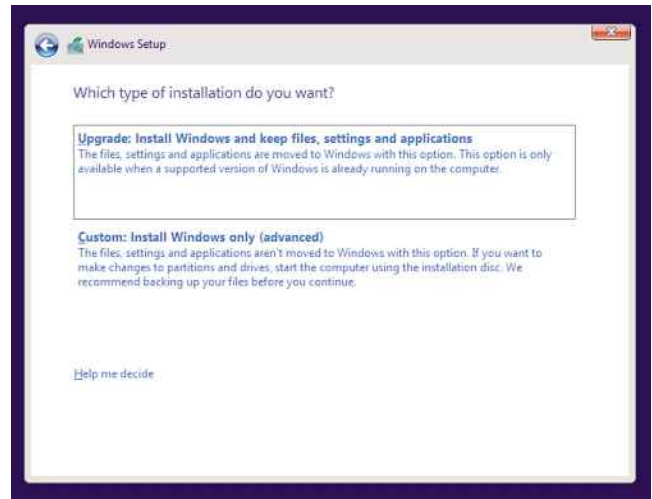
**1** You first need to make sure your computer is set to boot from your DVD drive or from USB. Insert your DVD or USB installation disk and restart your PC. You may find that your PC has a special boot override menu, which you can access with a key such as F10; look out for the message while your computer starts. If this is the case, press the key as soon as the message is displayed, then select your DVD drive or USB stick to boot from.

If you don't have a boot override menu, you'll need to go into the BIOS or UEFI Setup program, which is where you change some of your computer's more low-level settings. The right key to enter Setup varies from PC to PC, but is usually Delete, F2 or F10, and you'll need to press it almost immediately after you turn on or restart your PC. If you look carefully, you may see the relevant key displayed onscreen as the computer turns on. Some modern laptops, such as certain Lenovo models, have a special button to enter the Setup program, which you'll most likely find next to the power switch.

**2** Once in Setup, find the Boot section. Now change the boot order to put the device you want to boot from first: this will be DVD or USB. Bootable USB flash drives are sometimes listed as hard disks. If this is the case you'll need to set 'hard disk' as the first boot option, then go into the hard disk boot order sub-menu and put your USB boot disk at the top of the list. Some modern laptops won't boot from USB unless you change from EFI to Legacy mode. If you enable this mode, you may find you can no longer install Windows 10 without wiping all your hard disk's recovery partitions. If you're not happy to do this, you should perform an upgrade instead (see page 96). Find and select the Save and Restart option or equivalent. Your PC should now boot into the Windows 10 setup program; you may see a message asking you to 'press any key to boot from USB', so do so.

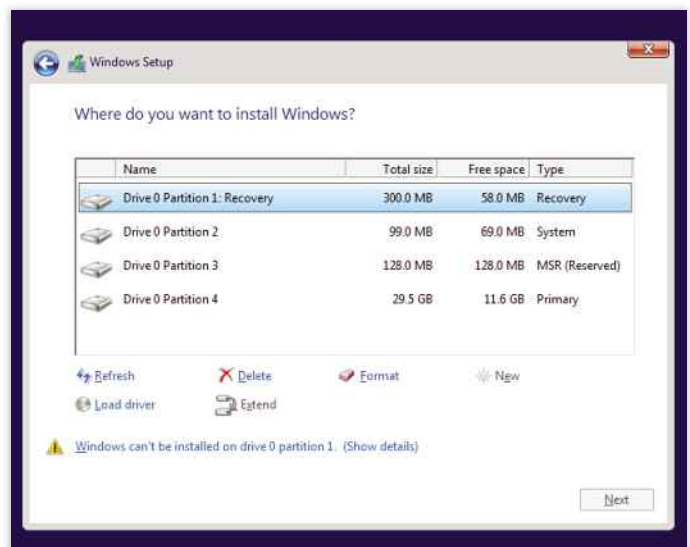


**3** Once you're in the Setup program, select your language, time, currency and input method, click Next, then Install Now. Enter your Windows key if prompted, and read and accept the software licence. In the next screen, select 'Custom: Install Windows only (advanced)'.



**4** What you'll see on the next screen depends on whether you're installing on a blank disk, or whether your disk has had an operating system installed on it previously. If it's a blank disk, you'll be shown a drive with 'Unallocated space', so just select it and click Next. Windows will then start the installation process.

If your disk has had an operating system on it previously, or if you have more than one hard disk in your PC, you'll be shown a screen with several disks and partitions. The disks will be called Drive 0, Drive 1 and so on, and if a disk has previously had a Windows installation it will be split into partitions with labels such as Recovery, System, MSR and Primary. It's easiest to delete all these partitions before you install Windows 10, but bear in mind that if any are recovery partitions, you won't be able to go back to your previous version of Windows. Quadruple-check that you're deleting partitions from the correct drive, and that you're absolutely sure you've already backed up everything you need, as you won't be able to get it back. Once you've finished deleting partitions, make sure the drive you want to use for your Windows 10 installation is selected and press Next to install it.



# Set up the Calendar application

The attractive new Windows 10 Calendar works with all kinds of accounts

**MICROSOFT'S CALENDAR APPLICATION** is intertwined with the new Mail program, so if you set up an account in one you'll instantly have it added to the other. Calendar supports Live Tiles on the Start menu to alert you to upcoming events, as well as Action Centre notifications, so it's definitely worth adding all your calendar/email accounts to help you stay on top of your diary. The Calendar app is in the 'Life at a glance' section of the Start menu by default; you can find it quickly by pressing the Windows key and typing Calendar.

## Calendar setup

The Microsoft account you used to set up Windows 10 will already be set up when you first open Calendar. If you set up Mail before you open Calendar, any accounts you add there will also appear here, but if you jump straight into the Calendar application and need to add another account, click the cog icon in the bottom-left corner of the app window to open the Settings pane on the right side of the screen. From here, click Accounts and then Add Account.

The pop-out menu that appears will let you add an Outlook.com, Live.com or Hotmail.com webmail address, or an Exchange, Office 365, Gmail or Apple iCloud account. If you have another kind of account, such as one from your ISP you access via

POP3, you'll need to click Advanced set-up.

Once you've entered your details, the program will begin syncing your calendar and adding entries to the month view.

Calendar displays a week view by default, giving you a seven-day overview of your upcoming appointments. You can change this to a detailed Day view, a Work Week view, which only shows Monday to Friday, or a Month overview for getting a general idea of exactly what you've got coming up over the next 30 days. All these views can be found at the top-right corner of the application. There's also a Today button, which will jump back to today's date after you've added a future event.

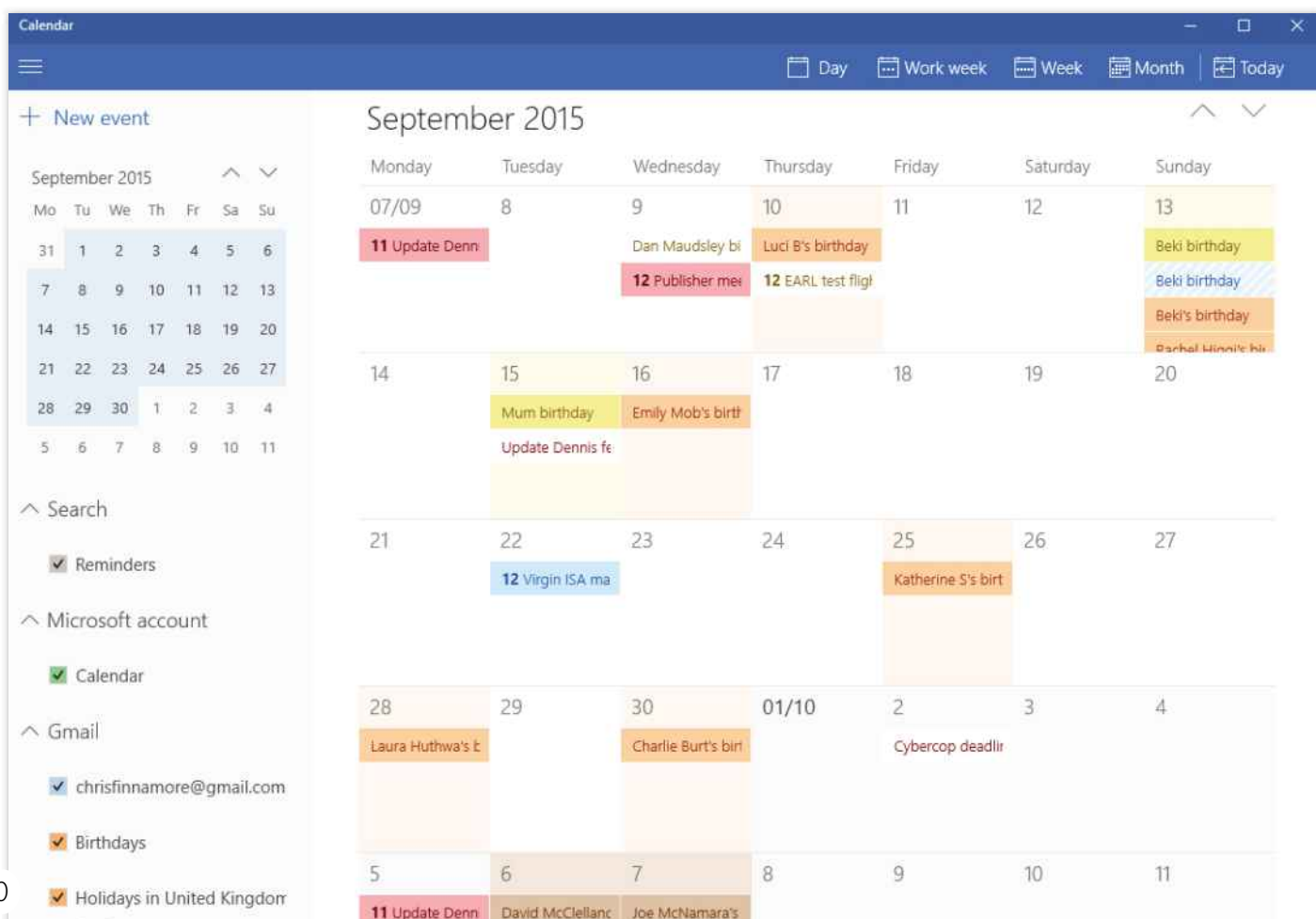
## Choosing calendars

As with the Mail application, Calendar hides its menus until you click the three horizontal lines icon in the top-left corner. This reveals a small month view, which lets you quickly jump to a specific day without having to scroll through the main calendar view, and lets you toggle specific calendars on and off. By default our Outlook webmail account added UK holidays and the birthdays of all our contacts, but you can hide these by clicking the coloured box next to each calendar in the list. Right-clicking a calendar here will let you change the colour of that calendar's events.

## Adding an event

To add a new event, simply click anywhere on the calendar view. A pop-up will appear, letting you name the event, set start and end times (or set an all-day event), add a location and assign the event to a particular calendar. Clicking a calendar entry you've created will expand the event to fill the screen, letting you amend details, add a more thorough description, drag in photos and invite other people. Those invited to the event will appear to the right of the screen. It's here you can set a reminder, from 15 minutes to one week before the start of the event. You can also add calendar appointments using the Cortana digital assistant (see page 107).

As in the Mail application, Microsoft has simplified Calendar as much as possible, leaving just a few entries in the Settings panel. Clicking the cog at the bottom-left, then clicking Calendar Settings in the panel that opens on the right, lets you set the first day of the week, the number of days in your personal working week, your start and end of work hours, whether to number each week of the year and whether to use light or bright colours for each Calendar account. Oddly, the first day of the week drop-down menu always displays Sunday as the selected entry, even if you've chosen another day, but everything else works as you would expect.





## How to...

# Set up Mail

Windows 10's powerful Mail client has some useful extra features

**MANY PEOPLE NOW** rely purely on webmail for their email, but Windows 10's new email client is so easy to use it's a viable alternative. You also get the benefit of Live Tiles in the Start menu, and optional notifications in the Action Centre. Like Calendar, Mail is in the 'Life at a glance' section of the Start menu by default, but you can find it quickly by pressing the Windows key and typing Mail.

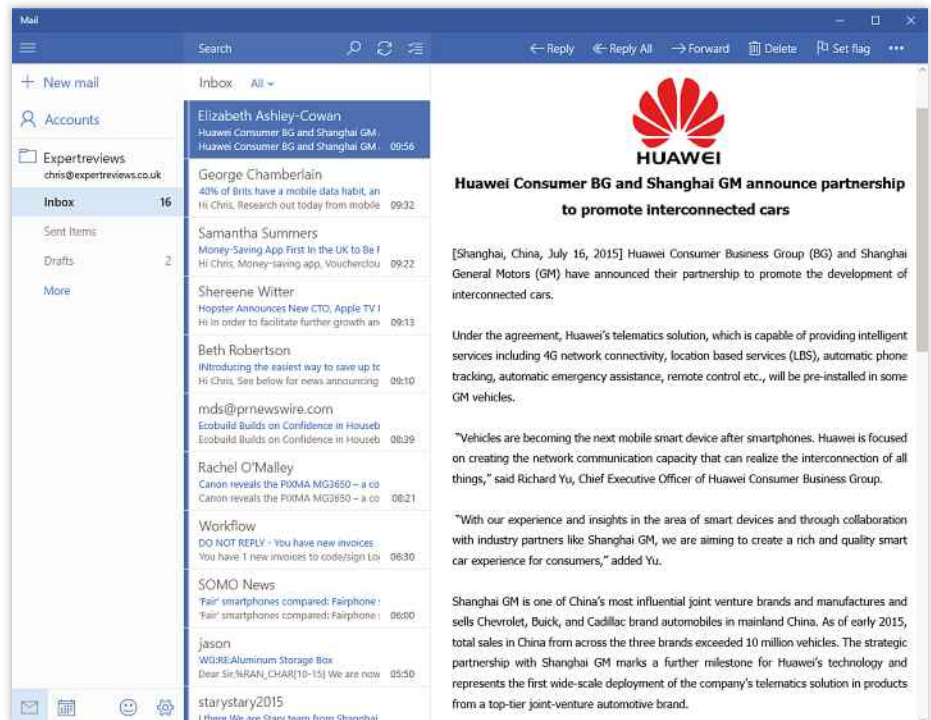
If you used your Microsoft account when setting up Windows 10, your Hotmail, Live mail or Outlook.com email accounts will already be set up when you first log in. If you want to use Mail for your other accounts, however, you'll need to set them up. Mail makes this easy by prompting you to add new accounts when you first open the application.

## Setting up a Mail account



Click 'Ready to Go' straight away if you only plan on using your Microsoft account, but if you have other email accounts you'd like to use, click Add Account. Mail supports Outlook.com, Exchange, Gmail, Yahoo! Mail and iCloud accounts by default, and you can also configure POP and IMAP accounts if you have one, such as the one from your ISP.

If you set up a webmail account such as Gmail, a new window will open and ask you to sign in to your Google account. You can then authorise the app to access your account information, and it will take care of the rest.



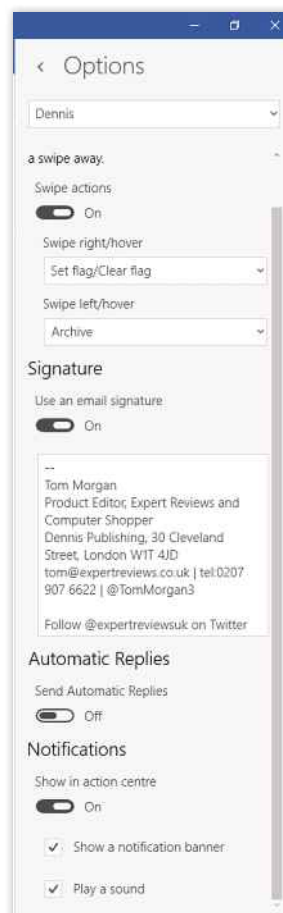
For Exchange accounts, things are more complicated. You'll need to know your email address and password and, depending on the Exchange server settings, you may also need to provide a username and domain. If you don't know these, your network administrator or IT department should be able to help you. Once you've put in the correct details, the account will be activated and Mail will begin synchronising your inbox.

## Using Mail

Now that all your accounts have been added, you can start sending and receiving email. If you're moving across from Outlook or Microsoft's webmail services, you might find navigation a bit alien, but essentially everything you need can be found in the menu on the left of the screen.

Accounts and folders are hidden by default, but you can click the menu icon in the top left corner (three horizontal lines) to reveal all your accounts and a selection of pinned folders. Clicking More at the bottom of this list will open a new pop-out menu containing all your mail folders; if you would prefer these to be always visible, you can right-click each one and

select 'add to favourites'. You can also make these folders appear when the menu is minimised by clicking the silhouetted folder icon. The Calendar icon at the bottom left will open the Calendar application (see opposite), while the Cog icon opens the Settings pane on the right of the screen.



## Mail settings

The Settings pane lets you add more accounts, and you can dive into the Options sub-menu to set out-of-office replies, add a signature to your emails and toggle Action Centre notifications. It's also here you can fix some of the annoyances we've encountered in our time with the application.

For example, by default Mail won't highlight the next message in your inbox when you delete, move or archive the currently selected email. Instead, the entire preview pane is filled with a generic cloud image. If you open Options at the bottom left (the cog icon) and click Reading, you can toggle 'Auto-open next item' if you prefer. You can also change the background image by clicking Background Picture in the Settings menu.

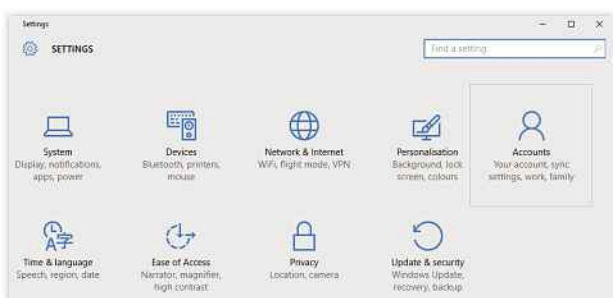
## Add a user account

If more than one person will be using your Windows 10 PC, each user will need their own account. Here's how to get them set up

**WHEN YOU FIRST** install or upgrade to Windows 10 you'll be asked to create your personal user account, using an existing Microsoft account. Signing in with a Microsoft account is useful, as it means you're already set up and ready to go with OneDrive cloud storage, can download apps straight from the Store and will get better personalised search results with Bing. If you'd rather not sign up for a

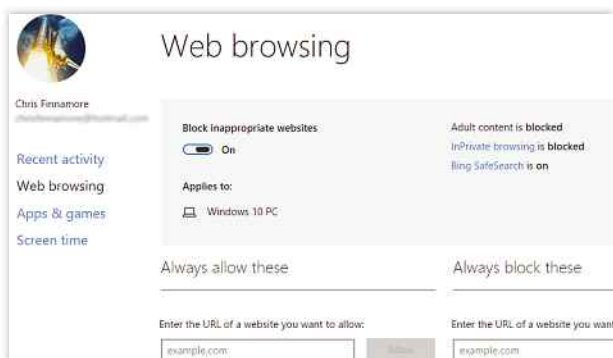
Microsoft account, you can click the 'Skip this step' link at the bottom to create a traditional Windows account instead.

If you're planning on sharing the system with others, it makes sense to create separate accounts for each new user. Microsoft has made this process a little more complicated in Windows 10 than it was in previous versions of the operating system, but our guide will help.



**1** Open the Settings panel by clicking the Start menu and selecting Settings. The old User Accounts entry still exists in the Control Panel, but it only lets you change the account type; for most settings you need to use the Windows 10 settings application.

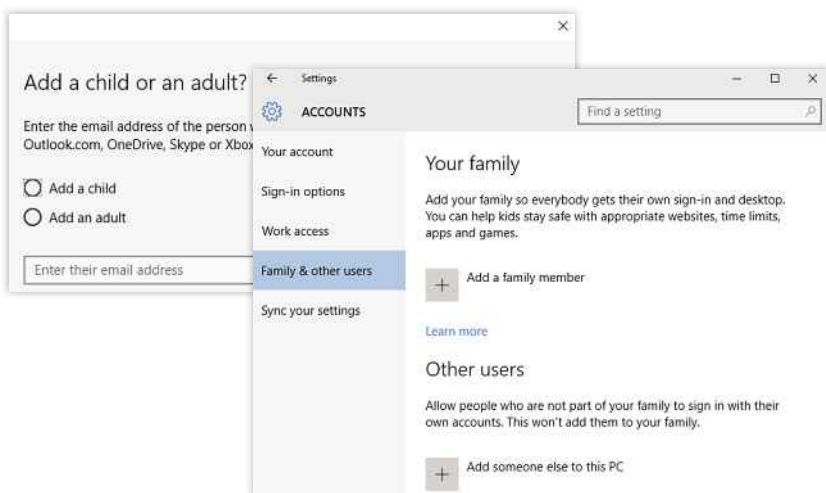
**3** Once you've added family accounts, those users will get an email inviting them to join your family. When they've accepted, you'll be able to use the Windows website at [account.microsoft.com/family](https://account.microsoft.com/family) to monitor web browsing, limit screen time, block certain websites and get regular activity reports in order to keep an eye on younger users. For example, if a child tries to visit a blocked site, a web page will appear instead, giving them the option to ask an adult for permission over email.



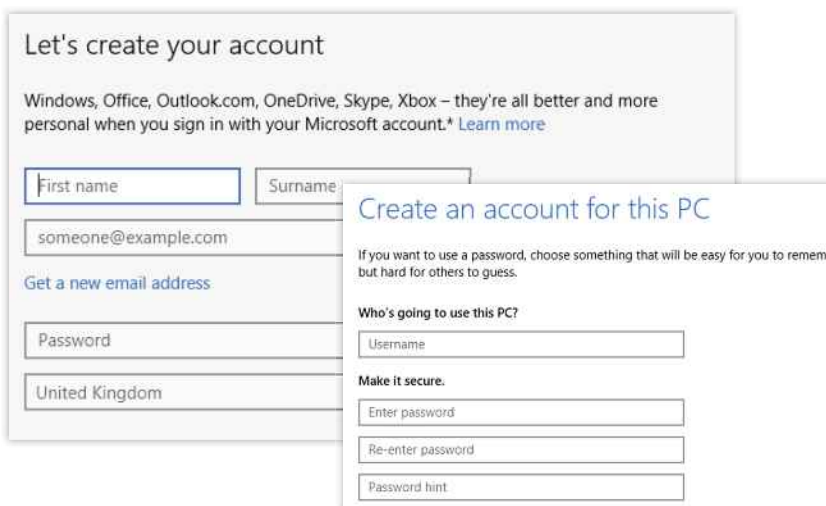
**5** Once you've set up your additional accounts, the next time you reboot or log off your PC the new users will appear to the bottom-left of the login screen.



**2** Click Accounts, then click Family and Other Users in the left-hand side panel. From here, you can either add a new family member, which gives you the option to set parental controls on your children's accounts, or simply add a new user. If you choose 'Add a family member', each person you add will need to have their own Microsoft account. You can also create Microsoft accounts from here by clicking the 'The person who I want to add doesn't have an email address' link.



**4** Microsoft tries to do everything in its power to force you to use a Microsoft account when adding a new user, but it is possible to avoid this and use a local account instead. Click 'Add someone else to this PC', then click 'The person I want to add doesn't have an email address'. On the next screen, click 'Add a user without a Microsoft account'. Finally, type in a username and, if you want one, a password.





## How to...

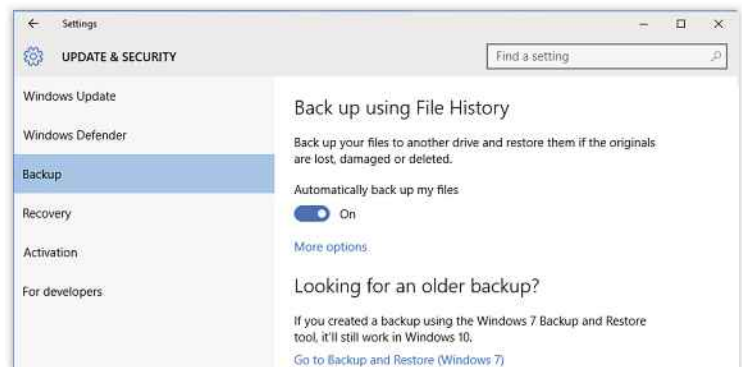
# Back up and restore your files

Setting up a backup is a vital first step on any OS. Here's how to do it in Windows 10

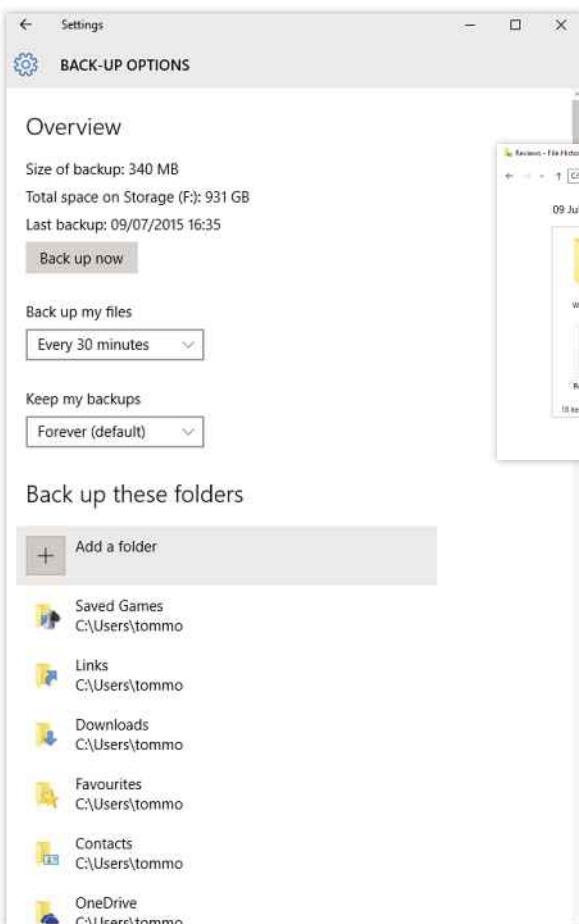
**WITH ANY COMPUTER** storage device, it's not a question of if it will fail, but when. For this reason, it's worth setting up a backup routine as soon as possible. With Windows 10, Microsoft has simplified the process of creating a backup, meaning there's no longer any excuse for losing important files if your hard disk or SSD goes pop.

You first need to make sure that your backup disk is connected to your PC. You can use an external disk such as a USB drive if you have one, or you can assign an internal disk as a backup destination. It is of course vital that your backup disk is separate from the one containing all your files.

**1** Open the Settings panel by clicking the icon at the bottom left of the Start menu. From here, click Update & security and then select Backup from the panel on the left.

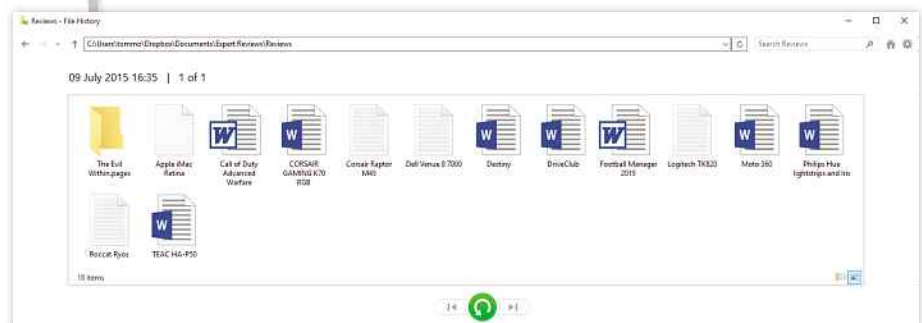


**3** Clicking More options opens a new window, where you can force a backup task to run immediately rather than on a set schedule with the Back up now button, change the length of time between backups, set how long your backups will be kept (permanently, until the disk runs out of space, or a specific length of time), and add or remove folders to be backed up.



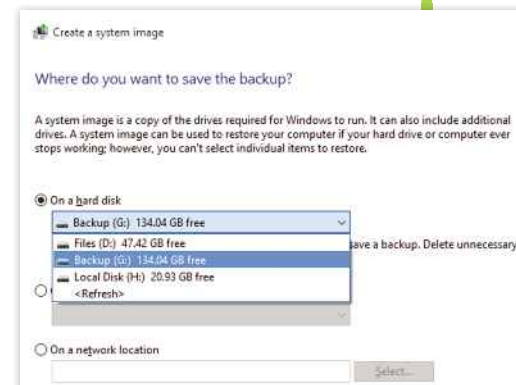
**2** You'll need to assign your disk as a backup destination. Click the big + symbol next to 'Add a drive' and select your disk from the list that appears. Windows will automatically assign a number of folders to be backed up, including Pictures, Videos, Documents, the camera roll, Downloads and the desktop.

**4** If you want to retrieve a lost file from a previous backup, scroll down to the bottom of this window and click 'Restore files from a current backup'. This will open a new window, where you can browse through your entire backup by folder, preview your files to check you've got the correct version, and restore a file to its original location.



## LEGACY BACKUPS

If you created a backup using Windows 7's Backup and Restore tool, you can restore it in Windows 10. Clicking the link in the Backup window will open the legacy Windows 7 File History tool, which lets you restore any backups on your connected disks. This tool is also the only way to create a system image of your Windows 10 installation without using a third-party utility.

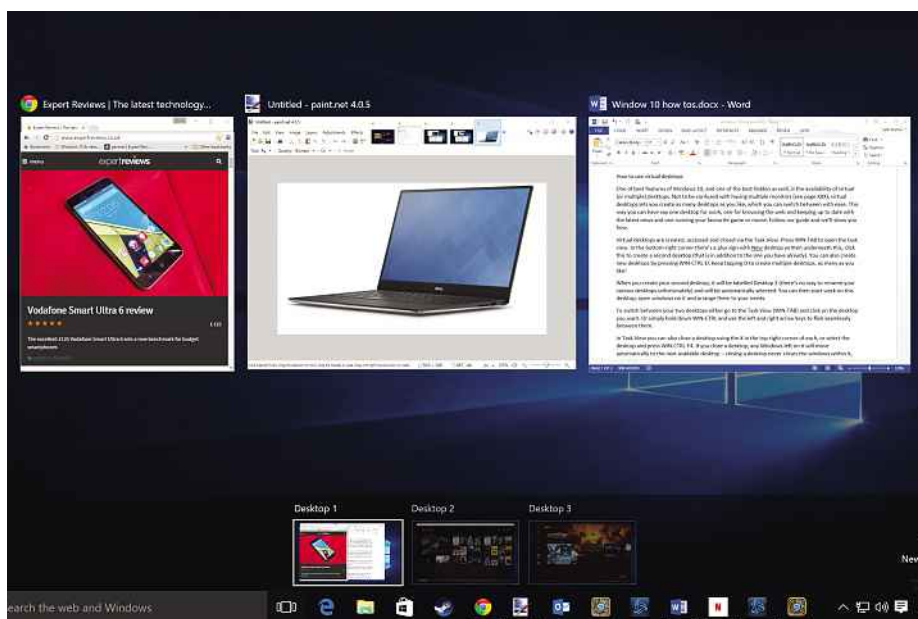


## Use virtual desktops

Keeping all your applications organised is much easier with Windows 10

**ONE OF WINDOWS 10's** best new features, which has been available on OS X and Linux for ages, is support for virtual desktops. This lets you create as many desktops as you like, which you can switch between with ease, so giving you some of the advantages of multiple

monitors on a single screen. Once you've set up your virtual desktops, you can have one desktop for work, one for browsing the web and one running a game, for example. Here's how to use virtual desktops to get organised.



**1** Press Windows-Tab to open the task view. In the bottom-right corner you'll see a plus sign with 'New desktop' written underneath. Click this to create a second desktop. You can also create new desktops by pressing Windows-Ctrl-D; there's no limit on how many desktops you can create and they appear to use minimal resources, so you can create as many as you like.

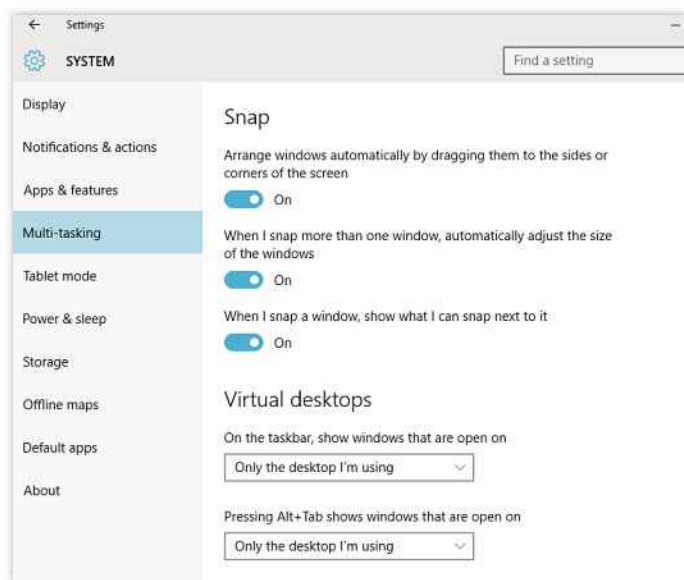
Once you've set up your virtual desktops, you can have one desktop for work, one for browsing the web and one running a game

**2** When you create your second desktop, it will be labelled Desktop 2, and will be automatically selected. You can then start work on this desktop, opening windows and applications and arranging them according to your needs. To switch between your two desktops you can either go to the Task View by pressing Windows-Tab and clicking on the desktop you want, or simply hold down Windows-Ctrl and use the left and right arrow keys to flick seamlessly between them.



**3** In Task View you can also close a desktop by clicking the cross in its top-right corner, or select the desktop and press Windows-Ctrl-F4. If you close a desktop, any applications or windows on that desktop won't close, but will move automatically to the next available desktop. Any application that allows for multiple instances of itself, such as the Chrome browser, lets you run different program windows on multiple desktops. If you want to move a window or application from one desktop to another, make sure you're currently on the correct desktop, then press Windows-Tab and drag and drop the window on to one of the desktops shown at the bottom of the screen.

**4** By default, if you press Alt-Tab to switch tasks, only the windows and applications currently running on that desktop will appear. The Taskbar will also only show programs that are open on the desktop you're currently using. You can change this behaviour using the options in Settings, System, Multi-tasking (just type 'Multi' into the Start search). In the 'Virtual desktops' section of this Settings menu, you can change both options from 'Only the desktop I'm using' to 'All desktops'. This will let you access any window or application with Alt-Tab or the taskbar, with Windows switching automatically to the correct desktop as you select the program.





# Task Switcher and Task View

Windows 10's improved application management makes for some efficient multitasking

**WINDOWS 10 GIVES** you several ways to switch between running windows and programs (collectively known as 'tasks') and, unlike the Flip 3D feature in Windows Vista and 7, all of them are useful. Switching quickly between one application and another is essential

if you want to get things done efficiently, or you can switch between an office document and a game if you want to work and play in tandem (or you have a short attention span). Here's the lowdown on Windows 10's improved Task Switcher and the new Task View.

## Task Switcher

The main way of switching tasks is still the Alt-Tab keyboard shortcut. Press the two keys together to open Task Switcher and then, while holding the Alt key, tap Tab to flick through the available tasks before releasing Alt to switch to the task you have selected. Alternatively, keep holding Alt and click your chosen task with the mouse.

Task Switcher is much improved over the Windows 8 version, with larger icons that really let you distinguish between different windows or applications. If you're still not sure which task you need, just check the text labels at the top of each task. If you're using multiple monitors, the Task Switcher will appear only on your main monitor.

A new feature in Windows 10 is that you can now close tasks from Task Switcher; just click the 'X' in the top right-hand corner of the task to close it. You can also switch tasks in the new Task View. This is accessible via the Windows-Tab shortcut, by swiping three fingers across your touchscreen or touchpad, and by clicking or tapping on the



↑ The new Task Switcher gives you much larger thumbnails than in previous versions of Windows

Task View icon on the taskbar, just to the right of the Cortana search box.

## Task View

A feature that Windows has been crying out for is an application view to rival OS X's Mission Control. The new Task View is just that. Pressing Windows-Tab brings up all your

currently running tasks in a big grid. If your PC has multiple monitors, tasks will appear on the monitor on which they're running. You can then use the mouse to select a task or close a task by clicking the 'X' in the top right.

The Task View is also where you manage and create your PC's virtual desktops (for more information on this, see opposite).

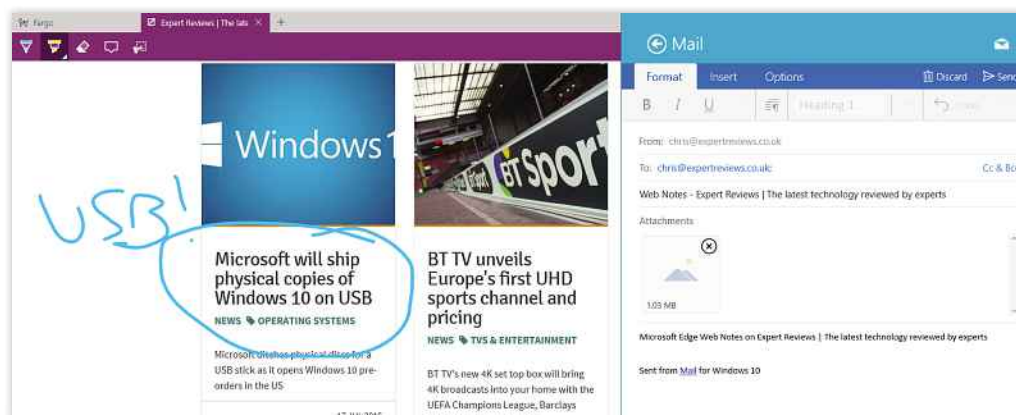
# Sharing notes with Edge

The new Edge browser lets you share annotated web pages with other Edge users

**WINDOWS 10 COMES** with a new browser called Edge. This lets you share web pages straight from the browser, complete with your own personal notes and annotations. Simply click the Make a Web Note button in the top-right corner of the browser and Edge will bring up a toolbar at the top containing everything you need to let you scribble over your chosen web page as you please.

There's a wide variety of different pen colours to choose from, and you can also use the highlighter tool to highlight areas of the page if you'd rather not write on top of it. Alternatively, if you only want to share and annotate a certain part of a web page, you can use the Clip tool to cut it out.

Once you've finished making your annotations, hit the Share button (a circle with three dots at the top right of the browser window) and you'll see a choice of applications to use to share the page, such as Mail or OneNote. The app will then open in a



↑ Edge lets you scribble on a web page then send the page as a screenshot over email in a couple of clicks

pane on the right of your screen, so you can quickly send an email or add it to your OneNote Notebook and go straight back to browsing the web. If you share a web page over email, it will be attached to the mail as a

JPEG image with your scribbles and highlights. Alternatively, click the Save icon to save the page and clipping to OneNote, your Favourites folder or Reading List, to save the clipping to read later.

## Master window management

Windows' impressive window management has been taken up a notch in Windows 10

**THE ADVENT OF** multiple browser tabs has helped us cut down on the number of applications we have running at any one time, but even so it can still be hard to keep tabs on all your running applications and

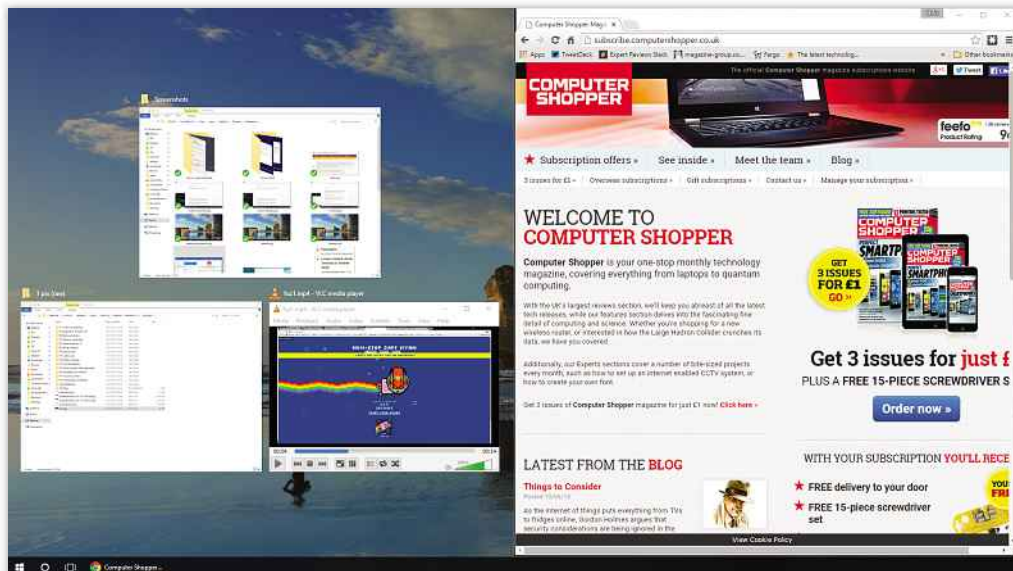
open windows. Windows 10 makes things easier for you by expanding on the window management features of 7 and 8, with lots of handy ways to organise your windows with mouse, keyboard or touchpad.

**1** As with previous versions of Windows, you can quickly resize an application in a number of ways. If you grab a window and move it to the edge of your desktop, when you're close to the edge you'll see a translucent outline showing you how the window will look when you release the button. Dragging a program to the top of the screen will make it fill the display, dragging to the left or right will snap the window to that half of the screen, and going to any corner will make the window fill that quarter of the screen.

**2** You can achieve the same effect using the Windows key and arrow keys. While holding down the Windows key, use the arrow keys to flick your selected window around the screen. For example, press Windows-right to move the application to fill the right half of your display, then press up or down to go into a quarter-screen mode, or press Windows-up to make the program fill the display. Pressing Windows-down will minimise the application.

If you have multiple monitors, and keep flicking an application to the left or right, eventually it will flick to another monitor. You can also hold down the Windows key and Shift, then use the left and right arrow keys to flick applications between monitors.

**3** If you move a window to the left or right of the display and have other windows and applications open, when you release the



↑ If you snap a window to one side of your screen, Windows will suggest other open windows to fill the rest

window you'll be prompted to select another open window to fill the other half of your display. You can click the item you want to fill the rest of the screen, or close unwanted windows by clicking the X in the top-right corner. Clicking back in the first window you moved or pressing Escape gets rid of the other windows. The same thing will happen with quarter-size windows when you move a window or app to a corner of your display.

**4** If your desktop is a cluttered mess, you can grab a window and shake it back and forth quickly to minimise all other programs. It's a great way to clear everything out of the way so you can concentrate on one task. If you do this accidentally, release the window, select and shake it again to put all your other windows and programs back where they were. You can also minimise all your windows and applications by pressing Windows-D.

### TAKE YOUR TABLETS

If you're using a tablet or a touchscreen-equipped laptop, you can switch to Tablet mode by swiping out from the right-hand side of the screen and tapping the Tablet mode button in the Action Centre.

In Tablet mode you can switch between apps by tapping the Task View button on the taskbar or by swiping in from the left of the screen, then selecting the app you want.

With an app running full screen you can then swipe down from the top of the screen and take control of that app.

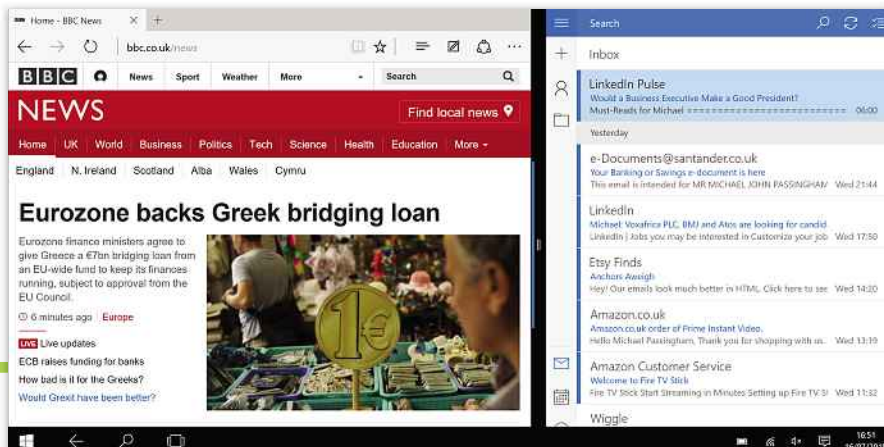
Dragging it to the bottom of the screen closes it, while moving it to the top switches it back to full-screen mode.

Drag an application to the left or right of your tablet's display and it will fill half the screen. If other apps are open you can

then select one to fill the other half, or open a new app from the Start menu, which will then fill the empty space automatically.

You can adjust the dividing line between the two apps by dragging the bar between the apps in the middle of the screen. This

way you can make one app bigger and the other smaller. To make one app fill the screen again, simply grab it by sliding your finger down from the top of the display above it, then push the app back up to the top of the screen and release it.

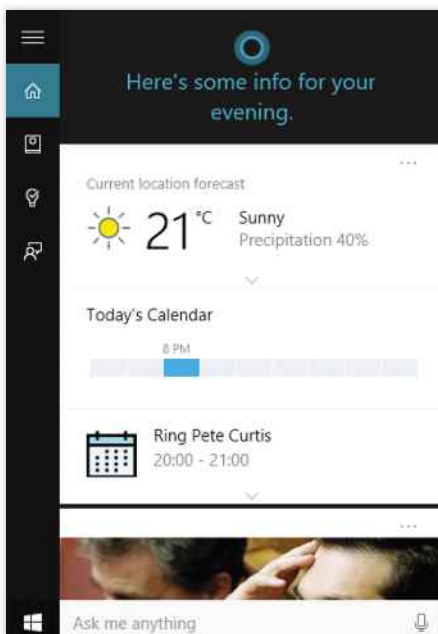




# Cortana explained

Microsoft's personal digital assistant is built into Windows 10. Here's what it can do

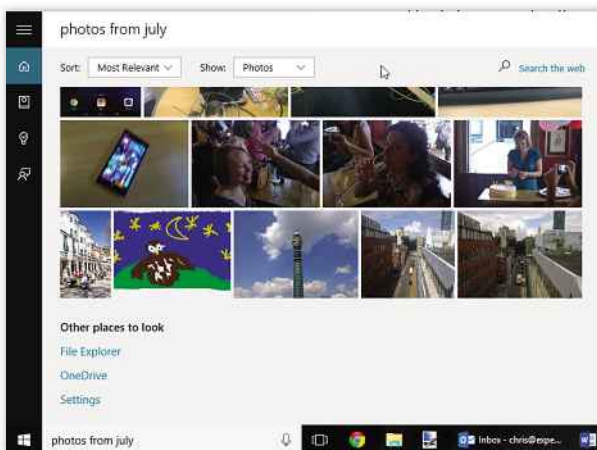
**CORTANA IS MICROSOFT'S** personal digital assistant. In a similar way to Apple's Siri on iOS, it can search the web to answer questions, set reminders and manage your calendar. It made its first appearance on Microsoft's Windows Phone 8.1 operating system, but in Windows 10 Cortana is built into your desktop, letting you search your PC and much more, using your keyboard or a microphone.



↑ Cortana gives you real-time information according to the preferences you set

## Launching programs

One of the biggest changes to the Windows 10 desktop is the search box built into the taskbar. Click 'Search the web and Windows' and Cortana will spring into action. Just begin typing and Cortana will start looking for anything that matches your chosen search terms, including files and programs on your PC and popular web searches.



↑ Cortana will interpret loose search terms, such as 'photos from July'

To launch a program, all you need to do is type in the name of the program in the search bar, tap Return and Cortana will launch it.

## Searching your PC

You can also type straight into the search bar to find individual files, folders, settings and applications. Typing in exact filenames will help pinpoint things much faster, but if you can't find what you're looking for, the My Stuff tab will present you with a more detailed breakdown of everything that matches that search term on your PC, excluding other items such as internet search results.

This breakdown includes lists of folders, documents, photo thumbnails, music, video and OneDrive files, but you can refine these results further by selecting individual file types in the top drop-down menu or through sorting by Most Recent or Most Relevant. Alternatively, you can ask Cortana to search other locations from the My Stuff screen, such as File Explorer, Settings, OneDrive or the web.

Cortana can also interpret more ambiguous commands, which is useful if you can't quite remember specific file titles. Type 'photos from July', for example, and Cortana will look for all the pictures you took in that month. However, this works only with photos in OneDrive; photos from the same month stored in other locations don't appear in the search results.

## Searching the internet

If you'd rather do a quick search for something online, type in your search term and select the Web tab instead. This will open the Edge web browser and perform a Bing search for your chosen terms.

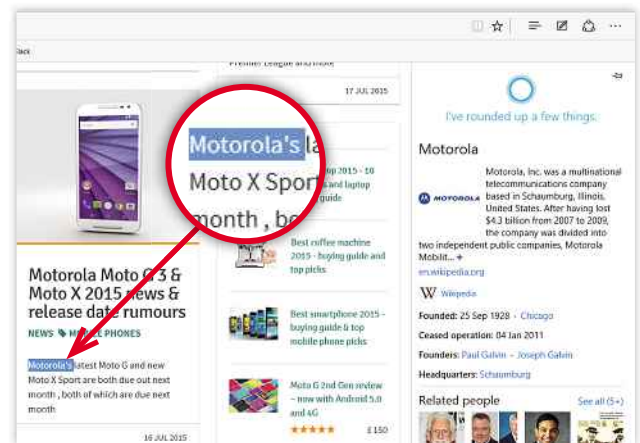
Alternatively, you can search with your voice (laptops and tablets have microphones built in, but you'll most likely need an external model or a webcam on a PC). To enable voice search, click the microphone icon on the right of the Cortana search box. You can also set Cortana's voice recognition to turn on automatically when you say "Hey Cortana". To enable this, bring up the Cortana search box, click the Notebook icon (just below the Home icon) and click Settings. Flick the switch under 'Hey Cortana' to On. Now you'll be able to say "Hey Cortana" into your microphone

followed by what you want to search for and Cortana will perform a Bing search without you having to lift a finger.

We had varying amounts of luck using voice control on tablets, laptops and PCs; we sometimes had a 'Microphone is not designed for Cortana' message, but voice recognition still worked to a certain degree. We could perform simple searches such as "Find Nando's", but more complicated ones such as setting a reminder to feed the dog were impossible; "feed" always came out as "pizza".

## Cortana and Edge

Cortana is also built into Microsoft's Edge browser. Highlight any phrase on a web page and right-click, and you'll see an option to Ask Cortana more about it. A sidebar will then

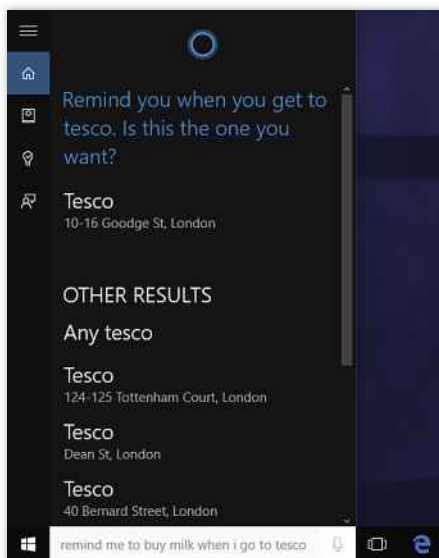


↑ Highlight a word on a web page and Cortana will look it up

appear on the right-hand side of the browser with Cortana's answer. Most of the information is derived from Wikipedia entries or Bing searches, but Cortana can also incorporate image searches and show other related search items. For example, if you search for a company or organisation, Cortana will show you social media information, such as a link to its Twitter page, as well as other people related to that company.

Likewise, if you highlight the name of a chain restaurant, Cortana will give you directions to the nearest one based on your location. If there's telephone information, there'll even be an option to call for a reservation, which you can do through Skype on your PC or with your smartphone if you're using Windows 10 Mobile (see page 108).

If you want to find out more about what Cortana has found, you can click the relevant link; each link opens in a new tab. Clicking outside the Cortana pane will make it disappear from view, but you can always pin it to the side of the Edge browser using the pin icon at the top-right if you'd like to refer to the Cortana search results while browsing.



↑ You can set location-aware reminders

## Setting reminders

Cortana isn't simply a fancy search tool, as it can also interact with your calendar and set reminders. As with search, you can either type in your reminder or appointment or vocalise it by saying "Hey Cortana" followed by your request; as we mentioned above, though, we didn't have much luck setting reminders vocally. You can also add reminders by selecting the Reminders lightbulb on Cortana's menu tab on the left.

Cortana will ask you what you'd like to be reminded about, where you'd like to be reminded or when you'd like to be reminded. You can also associate a reminder with one of your contacts, so Cortana will remind you to send a birthday card, for example, next time you speak to your mum.

Some reminders, such as those based on location, will only work if you have a phone

running Windows 10 Mobile. Reminders you make on your PC are synced with your phone automatically. Any calendar appointments you make, on the other hand, are synced to your Outlook calendar, so you'll be able to pick them up on both Android and iOS devices as well as Windows phones.

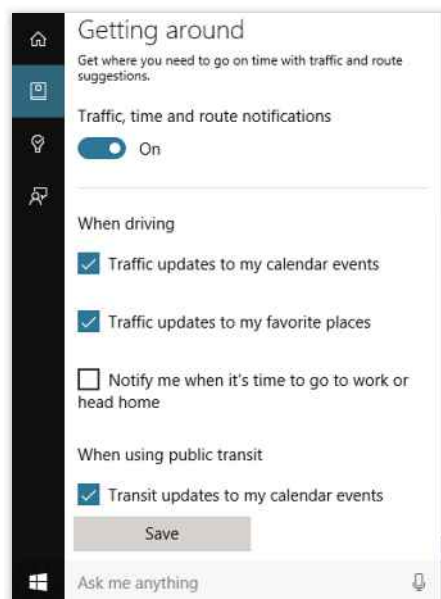
When we tried Cortana's location-based reminders, we found we had to be standing right outside our intended destination before Cortana sprang into action to remind us to buy some groceries, and even then it was a bit hit and miss. Sometimes our phone vibrated with a notification while it was in our pocket, but during other attempts we were only given the reminder when the phone was unlocked. Sometimes it just didn't respond at all, so don't rely on reminders to work if you're just in the general area of the relevant location.

## Organising your Notebook

As you'd expect from a personal assistant, Cortana can also keep track of your interests and hobbies in order to suggest useful links and tips. For instance, if you tell Cortana you like eating Mexican and Italian food, it will list popular restaurants related to that particular cuisine when you next open the search box.

To set up your preferences, you'll need to open Cortana's Notebook tab in the menu on the left. This lets you manage your various preferences, such as how Cortana behaves regarding food and drink, weather, events, finance, news, sport and transport information, as well as personal information such as your name and your home and work locations. For each category, you can choose whether Cortana will give you relevant information, such as local restaurant recommendations or traffic updates.

The Notebook can also be used to manage your connected accounts. This allows Cortana to interact with other programs such as Office 365 and Mail so it can pull out important information to add to your calendar. This includes flight details, restaurant reservations and parcel deliveries. In the case of Office 365, Cortana can help you prepare for meetings, learn about the people you work with and remind you where you need to be next so you won't be late. These features weren't available for testing at the time of writing, and there's also no word on whether only Microsoft email accounts will be supported, or if Cortana will be able to scan all email accounts linked to the Mail application for relevant information.



↑ You can customise the kind of info you receive

# Windows 10 Mobile

Windows 10 is also coming to mobile phones later this year. Here's what you can expect

**WINDOWS 10 IS** also coming to smartphones, in the form of Windows 10 Mobile. Although it won't be released at the same time as Windows 10, we've been testing the latest Insider Preview build to give you an idea about what to expect when the new Mobile OS eventually launches later this year.

Most Windows Phone 8 and 8.1 smartphones will be eligible for a free upgrade to Windows 10 Mobile, but some handsets may take longer than others to receive the update. However, Microsoft has said it will aim to support the majority of today's current Lumia handsets, from the ultra-cheap Lumia 435 right up to

the Nokia Lumia 930. Some Windows Phone 8 handsets may not support every new feature available on Windows 10 Mobile, but at least Lumia stalwarts needn't worry about being left behind.

## Interface

The overall appearance of Windows 10 Mobile has changed very little since Windows Phone 8.1. The gaps between the Live Tiles have shrunk, giving the Start screen a cleaner, more streamlined design, but the main UI is still made up of either two or three columns of Live Tiles which you can arrange in any configuration you like.

One of the bigger changes in Windows 10 Mobile is that you can finally add a full-screen background image. Whereas Windows Phone 8.1 let you add Picture Tiles, which layered an image over semi-transparent Live Tiles, Windows 10 Mobile's background images now sit directly behind your Live Tiles, filling in those pesky black grid lines with an image of your choice. Full-screen background images also appear on the revamped All Apps screen, making Windows 10 Mobile look significantly smarter than previous versions.

You can also change the transparency of Live Tiles,

ranging from complete transparency, leaving you with just the app icons onscreen with no square around them, to full-colour blocks. Some Live Tiles, such as Skype, Twitter, Facebook and Mix Radio, can't be made transparent, but Windows 10 Mobile is certainly more flexible in terms of appearance than previous Microsoft mobile operating systems.

There are also dozens more accent colours available to help the interface better match your background, along with a handy new preview window so you can see exactly what your Start screen will look like before you commit to it.



## Action Centre & Settings



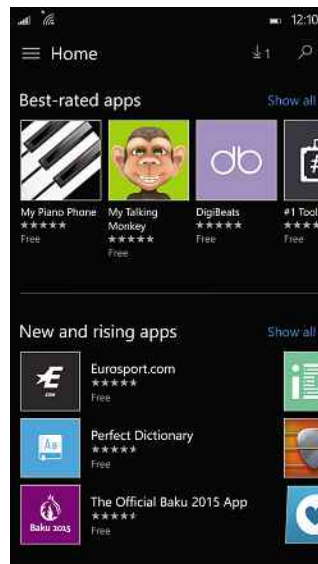
Windows 10 Mobile's Action Centre is an improved version of Microsoft's drop-down notification menu, first seen in Windows Phone 8.1. Here you'll find all your app and email notifications, as well as network information, remaining battery life and the time and date. You also get four customisable quick action shortcut buttons at the top, but in Windows 10 Mobile this can be expanded to show up to 16 shortcuts at once.

Microsoft has put a huge amount of effort into simplifying the main Settings menu, as the initial landing screen now looks identical to the Settings menu on Windows 10 desktops. Rather than simply listing each setting in a confusing list, you're now presented with clearly defined categories, including System, Devices, Network & Wireless, Personalisation, Accounts, Privacy, Updates & Security and Extras, along with a search bar at the top to help you jump straight to individual settings.

The search bar is particularly handy, but you do have to type in quite specific search terms to find the appropriate setting. Type in 'Screen', for instance, and the only available results will be 'Glance Screen' and 'Lock Screen' rather than any of the Display settings. Some settings also appear in rather unexpected locations. For example, some display options, such as sunlight readability, Glance Screen, battery saver and the brightness and colour profile settings, are all housed in the Extras category

rather than the main Display section in System. This is a little disappointing, especially since the desktop version of Windows 10 doesn't need an odds-and-ends Extras section, but at least the settings menus are more manageable than in previous versions of Windows Phone.

## Windows Store



The Settings menu isn't the only part of Windows 10 Mobile to use the same design as its desktop counterpart, as the newly revamped Windows Store also borrows heavily from the Windows 10 desktop Store. Taking several cues from Apple's App Store, the Windows Store now opens on a single screen with a large scrolling banner at the top with featured apps.

Below you'll find the best free and paid-for apps and games, along with app collections and apps labelled New and Rising. There's also a search tool, but a quick tap of the menu button in the top-left corner lets you sort apps by Games, Music and Films and TV to help ease browsing. You'll find your purchase history here, along with a library option, a list of apps you've downloaded and the Store settings menu.

## Calls & Messaging

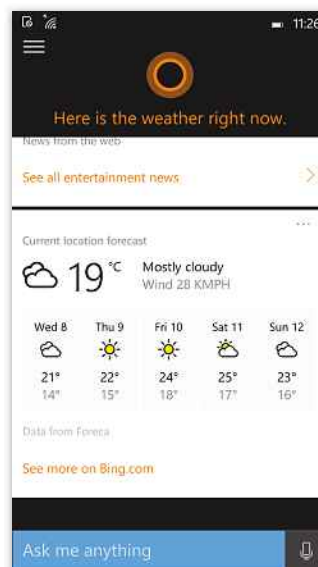
Windows 10 Mobile makes it simpler to reply to text messages. When a text comes in, instead of having to stop what you're doing and open the Messaging app, an actionable notification banner appears at the top of the screen. To reply, you simply pull down and tap out a quick message

without leaving the app you're using. You can also swipe up to dismiss the message, or look at it later in the Action Centre.

If a call comes in and you're too busy to answer it, simply tap the Text Reply button next to Ignore, and you can automatically send a text saying "I'll call you back", "Please text me" or your own individual message.

If you have a large Windows phone and only have one hand free, simply hold down the Home button and the entire operating system will shift to the lower half of the screen, bringing everything into easy reach. Unfortunately, this means the bottom of any screen will now be off the bottom of the display, which can cause problems accessing contacts with names beginning with Y or Z, for example. This should be fixed by the time Windows 10 Mobile comes out, however. Any phone with a 5in or bigger screen also lets you reposition the keyboard by pressing and holding the spacebar.

## Cortana

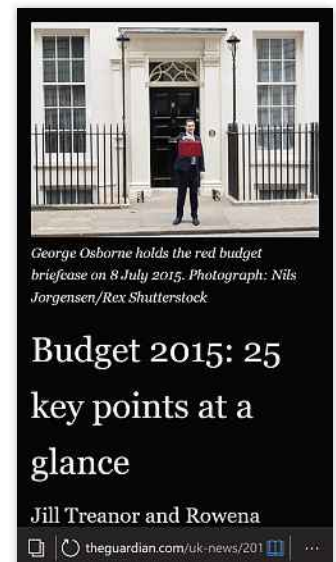


Cortana, Microsoft's personal digital assistant, has changed very little since it first appeared on Windows Phone 8.1. As in previous versions, you can ask Cortana questions that it will try to answer by searching the web, set reminders, and put your phone into silent mode using the Quiet Hours settings.

One of Cortana's additions is the ability to send dictated emails for you. This wasn't available in our build at the time of writing, but Microsoft has said

you'll be able to say everything at once, such as who you want to send the email to, including multiple people, the subject of the message, and what you want your email to say, and Cortana will be able to compile it all correctly into a single message. You'll even be able to make corrections with your voice.

## Microsoft Edge



Windows 10 Mobile also uses Microsoft's new Edge browser. This is broadly similar to Explorer; the address bar is still at the bottom of the screen, along with the tabs and refresh buttons, but you'll also find a new Reading View icon on the right next to the menu settings.

Not all web pages support Reading View, but those that do essentially strip out all the page formatting and online advertising to make articles easier to read. You can choose from a variety of font sizes as well as a dark, light or medium background. The dark background should be beneficial for Windows phones with AMOLED screens, as due to the way AMOLED screens work, the black background and white text should help save battery power during extended browsing.

You can also add articles to your Reading List to save for later. You'll find Reading List in Edge's new Hub, which can be accessed from the main menu. You'll also find your Favourites, History and Download tabs here, but Microsoft has yet to confirm whether these will be able to synchronise with the Hub on the desktop version of Edge.





# *Beyond* **SILICON**

**With silicon approaching its limits, Mike Bedford looks at what will be at the core of tomorrow's computers**

**F**or as long as most people can remember, the world of electronics has been fixated with a single chemical element: silicon.

This element forms the core of all the processors and memory devices that power our PCs, tablets, smartphones and so much more.

Electronics doesn't have to be the story of this semi-metallic solid, though. The very first electronic devices operated on very different principles, and some experts are suggesting that within the space of a decade further performance gains will become impossible as silicon reaches its limits. With our computing needs still increasing exponentially that's likely

to be a big problem, and so the search for an alternative has taken on some urgency.

Some experts even think electronics itself might be doomed and are considering whether optical, chemical or biological systems may provide the future computing capabilities we need. While this is a possibility, a new generation of electronics seems far more likely.

There's no shortage of contenders for the title of the successor to silicon. While some of the competing technologies would be best described as evolutionary, others are far more radical in their approach, while some of them might even be branded as totally off the wall.



## COMPOUND SEMICONDUCTORS

Silicon is a semi-metallic element, otherwise known as a metalloid, in Group IV of the periodic table. As it stands it's a poor electrical conductor but it can be made more conductive by adding small amounts of other elements, a process called doping. Doping with a Group III element makes silicon into a so-called p-type semiconductor, while doping with an element from Group V creates an n-type semiconductor. It gets interesting when areas of n-type and p-type semiconductor material are arranged in a particular way, as they are in today's processors and memories. The result is a transistor, the fundamental building block on which pretty much all electronic circuits depend. Silicon isn't the only element that can be used in this way. Several other elements in the same region of the periodic table show similar properties; indeed, some early transistors were made from germanium, also a Group IV semi-metallic element.

While germanium was found to be inferior to silicon in several respects, the search is now on to find alternative semi-metals that could outperform silicon and, perhaps, allow transistors to be made ever smaller, once silicon circuits can be shrunk no further. Only a handful of common chemical elements – boron, silicon,

III	IV	V	VI
<b>5</b> <b>B</b> boron 10.81	<b>6</b> <b>C</b> carbon 12.01	<b>7</b> <b>N</b> nitrogen 14.01	<b>8</b> <b>O</b> oxygen 16.00
<b>13</b> <b>Al</b> aluminum 26.98	<b>14</b> <b>Si</b> silicon 28.09	<b>15</b> <b>P</b> phosphorus 30.97	<b>16</b> <b>S</b> sulfur 32.06
<b>31</b> <b>Ga</b> gallium 69.72	<b>32</b> <b>Ge</b> germanium 72.63	<b>33</b> <b>As</b> arsenic 74.92	<b>34</b> <b>Se</b> selenium 78.96
<b>49</b> <b>In</b> indium 114.8	<b>50</b> <b>Sn</b> tin 118.7	<b>51</b> <b>Sb</b> antimony 121.8	<b>52</b> <b>Te</b> tellurium 127.6

## THE SEARCH IS ON TO FIND ALTERNATIVE SEMI-METALS THAT COULD OUTPERFORM SILICON AND ALLOW TRANSISTORS TO BE MADE SMALLER

germanium, arsenic, antimony and tellurium – are generally thought of as metalloids, and most have been discounted for one reason or another. However, there is considerable interest in alloys, produced by mixing together two or more semi-metallic elements as Rob Willoner, technology analyst at Intel, told us.

He started by explaining the benefits of compound semiconductors – in particular, indium gallium arsenide (InGaAs) – over silicon. “A channel – the region between a transistor's source and drain – made of compound semiconductors has higher mobility than a conventional silicon channel. Mobility is a measure of how fast the electrons move when subjected to a given voltage.”



◀ Silicon has served us well over the past 40 years or so, but could it be nearing the end of its life?

⬆ Although only a few elements (blue in our diagram) are metalloids, some alloys of Group III and V elements, and other combinations, are also semi-metallic

Silicon has an electron mobility of 1,400 cm<sup>2</sup>/Vs, and this is a figure that any viable alternatives need to beat. InGaAs has a mobility of 10,000 cm<sup>2</sup>/Vs, while graphene, which we'll discuss later, clocks up a massive 15,000 cm<sup>2</sup>/Vs, with some scientists suggesting that 100,000 cm<sup>2</sup>/Vs ought to be achievable. Electron mobility is related to conductivity, and we don't want to get too bogged down in the physics here, but suffice to say a high electron mobility is a prerequisite of any semiconductor material replacement for silicon.

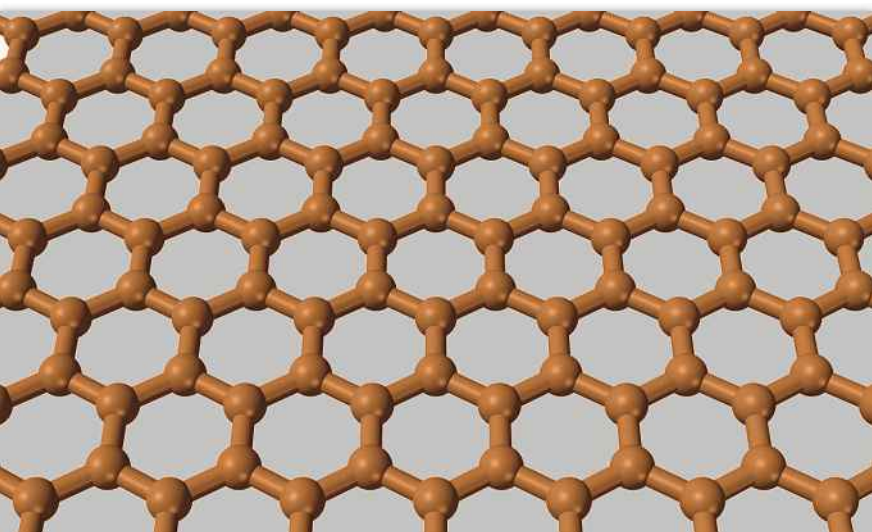
But this is only part of the story. “Another advantage of compound semiconductors is that they can operate at lower voltages than silicon – in the half volt region,” explained Willoner. “This dramatically reduces the power consumption of each transistor.” While the developers of some other post-silicon contenders are happy to quote dramatic performance figures, though, Willoner was much more cautious in his predictions, saying just that “compound semiconductors promise faster and more energy-efficient transistors, which will lead to faster, less power-hungry chips.”

He was even more guarded when we asked about timescales. “Deployment of any new technology involves a complex decision-making process, taking into consideration factors such as benefits, risks and cost”.

### CARBON WITH A DIFFERENCE

Many of us were taught in school chemistry lessons that carbon comes in two allotropes, namely graphite and diamond. The fact that different molecular structures of the same element can result in such markedly different properties is obvious just by





comparing these two substances. Graphene, the so-called 'lead' in our pencils, is soft and black and it conducts electricity, while diamond is hard and colourless, and is an insulator. All this changed in 1985 with the synthesis of Buckminsterfullerene, a new allotrope of carbon in which 60 atoms are arranged as a hollow, spherical molecule. Since then, many more carbon allotropes have been discovered, some of which have interesting electrical properties.

Graphene can be thought of as a layer of graphite just a single atom thick in which the atoms bond together to produce a hexagonal pattern, rather like a sheet of chicken wire. Its properties are remarkable. It's 100 times stronger than steel, weight for weight; it's the

↑ Graphene might be a superb conductor, but its lack of a band gap is a major stumbling block (Adapted from commons.wikimedia.org/wiki/File:Graphen.jpg)

best electrical conductor we know of; and as discussed above it has a high electron mobility, which means it's potentially useful for creating fast electronic devices. In fact, researchers at the Massachusetts Institute of Technology have demonstrated a graphene transistor that switched at an astonishing 427GHz.

So far so good, but that headline figure doesn't tell the whole story. In technical jargon, graphene doesn't have a band gap, as semiconductors such as silicon do. The upshot of this is that graphene transistors can't be fully turned off. For analogue applications this isn't a problem, but if they were to be used in digital electronic circuits they would leak current and, as a result, they would be hugely power hungry.

Much of the recent development of silicon-based processors has involved making them more efficient, so a technology that represents a return to the old days of power guzzling and overheating – even at lightning speeds – isn't going to find much support. Research continues into overcoming graphene's downsides but, meanwhile, other scientists are investigating the properties of closely related substances.

While carbon sits just above silicon in the periodic table, one place to silicon's right is phosphorous. Since elements that are close neighbours often have similar properties, we might expect these two elements to also form single-atom layers of chicken wire like graphene.

An allotrope of silicon called silicene has indeed been discovered, with exactly the same molecular structure as graphene, while a form of phosphorous called phosphorene is similarly two-dimensional. Indications are that both share graphene's excellent conductivity



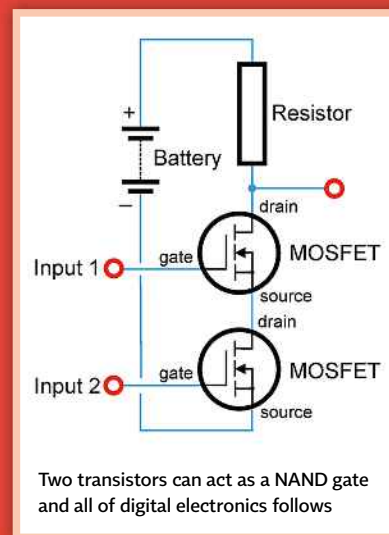
## DIGITAL ELECTRONICS

Throughout this article we've referred to the electronic switch as the most fundamental requirement of digital electronics. Essentially an electronic switch controls the flow of a current in one circuit by a voltage in another. Here we'll explain how this works.

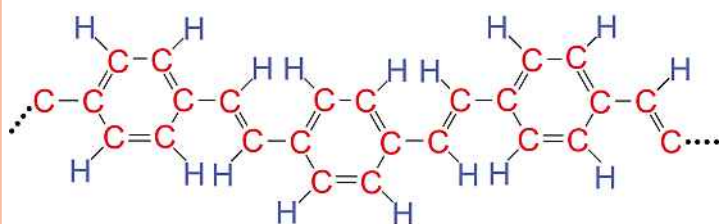
We've seen several materials, some of them quite exotic, that can act as electronic switches and which may conceivably power computers in the future. However, for the sake of argument, let's consider the most familiar type of electronic switch, the MOSFET, which is made primarily from silicon. A simple circuit using two N-channel MOSFETs is shown in the diagram. MOSFETs are switched on or off by the voltage of the electrode called the gate. If 0V is connected to both the circuit's inputs, this voltage appears on the gates of both MOSFETs so they are

turned off, which means that there's an open circuit between their drains to their sources. Under this condition, therefore, +5V appears on the output, via the resistor. If +5V is applied to either of the Inputs, the associated MOSFET will be turned on, effectively connecting its drain to its source, but a current still can't flow because the other MOSFET is turned off. However, if both inputs are +5V, both MOSFETs will turn on, effectively connecting the circuit's output to 0V.

What we've just seen is called a NAND gate, which stands for Not AND. It produces a binary 0 (which is represented in our circuit by 0V) as its output if both its inputs are 1s, otherwise it produces a binary 1 (which is represented by +5V volts). An equally simple circuit, but with the MOSFETs connected in parallel instead of in series,



can be used to create a NOR gate, and a simpler one still can act as an inverter. These simple logic functions are all that's needed to produce any digital circuit, even the most powerful and sophisticated microprocessors.



Alternating single and double bonds in the molecules of some polymers means they can conduct electricity

## COMPARED TO SILICON, A CARBON NANOTUBE CIRCUIT WILL BOTH BE FASTER AND MORE ENERGY EFFICIENT

but, crucially, they have the band gap that's necessary for creating transistors for digital circuits.

Transistors made from these two substances have so far shown modest performance, but it's still early days and research is hampered by these materials' highly reactive natures, most notably to the oxygen in the atmosphere. Silicene, for example, will self-destruct in just a few minutes unless it's handled in a vacuum. With interest in 2D molecules at an all-time high, though, scientists are hopeful that, if graphene, silicone or phosphorene aren't able to prove their electronic credentials, then perhaps germanene, antimonene, the yet-to-be synthesised stanene (2D tin) or one of their many potential cousins might fit the bill.

### CARBON NANOTUBES

Another carbon allotrope that has been discovered comparatively recently is the carbon nanotube. A good way of picturing a nanotube is as a piece of graphene, rolled up and with the edges joined together so that it

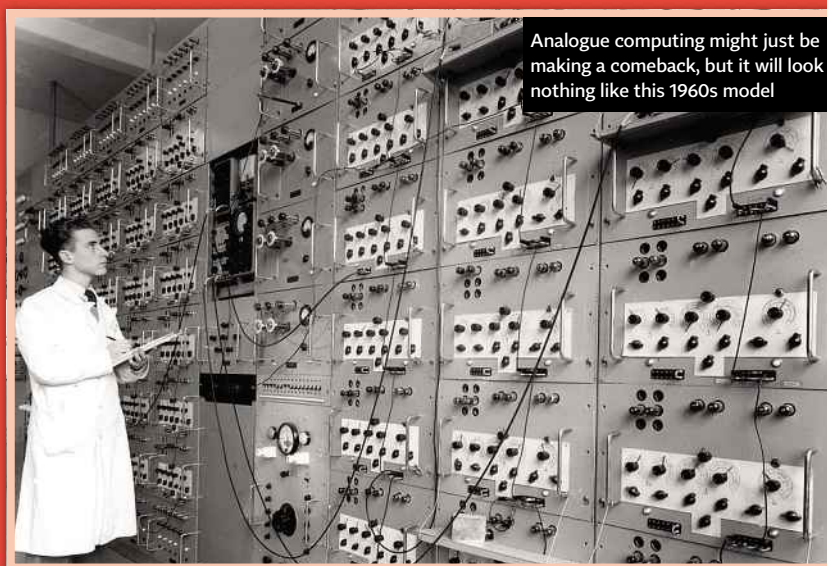


## THE LONG SHOTS

We've looked at several alternatives that might step up to the mark when silicon is eventually pensioned off. All these technologies are the subject of huge research interest. However, there are also some long shots that might just take us by surprise.

On page 117 we look at the valve technology that ruled the roost until the invention of the transistor, which cut prices, improved reliability and led to miniaturisation. Although the valve is over a hundred years old, though, not everyone has given up on it. NASA's Ames Research Center is attempting to bring it back from obscurity, but with a difference. Its so-called vacuum channel transistor is actually a miniature valve, built using modern semiconductor manufacturing methods, and capable of operating at 460GHz.

Another old technology that might have a bright future is analogue computing, something you may have thought died out in the 1970s. Instead of storing and manipulating data as strings of zeros and ones, analogue computers represent data as a continuously variable voltage. This may sound like an antiquated way of working but DARPA, America's defence-related research arm, has recently released a Request for Information called Analog and Continuous-variable Co-processors



Analogue computing might just be making a comeback, but it will look nothing like this 1960s model

for Efficient Scientific Simulation (ACCESS), inviting interested parties to contribute to advancing the technology to revolutionise how scientific simulations are performed.

Finally, we come to spintronics. This is by no means a new technology, even though it's yet to make a contribution to mainstream computing, but its adherents are convinced that its time will come. While conventional electronics relies on the charge of an electron to generate an electrical

current, spintronics works by manipulating another property of the electron which is known as spin and can take two values, referred to as up and down, that can represent binary zeros and ones. To cut a long story short, let's simply say that causing an electron to flip its spin requires much less energy than bringing about a corresponding change in conventional electronics, and electron flip is maintained even when the device is turned off. The benefits are not hard to imagine.



forms a hollow cylinder. Like graphene, nanotubes have some remarkable properties, but there's so much more scope for fine-tuning their structure and hence their properties.

Instead of a single type of carbon nanotube, there's an almost infinite number that could differ in their length, diameter and even whether their walls are just one-atom thick or are composed of multiple layers of graphene. Crucially, depending on their exact molecular structure, nanotubes can be either fully conducting like a metal, or have metalloid properties with the important band gap.

Carbon nanotubes were first crafted into a transistor 15 years ago, but wiring up sufficient numbers to create a computing device has been an uphill struggle. A major problem in creating nanotube circuits is that attempts to produce semi-conducting nanotubes will always result in a few fully conducting ones that would act as short circuits. However, researchers at Stanford University have developed a technique of burning out any of these metallic nanotubes and, in so doing, demonstrated a simple computing device containing 178 transistors.

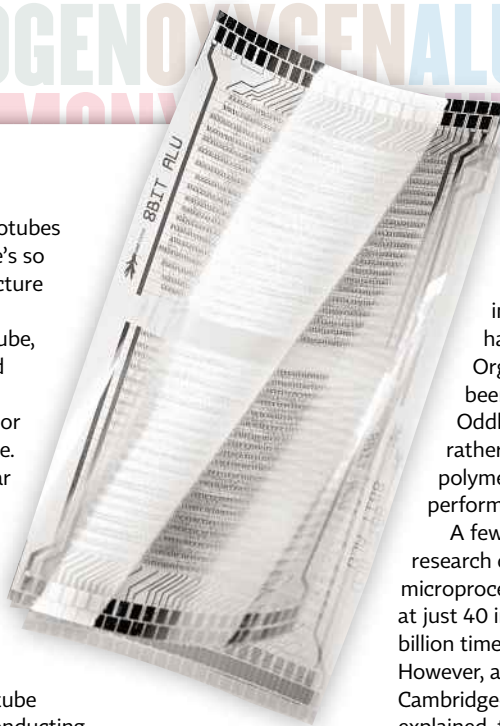
Bearing in mind that mighty oaks from little acorns grow, let's quote the upbeat Stanford's Professor Philip Wong. "Here is the punchline: compared to silicon, if you build a circuit out of carbon nanotubes, your circuit will both be faster and more energy efficient."

## THE PLASTIC REVOLUTION

If you were to ask most people to name an electrical insulator, the chances are that plastic would come close to the top of the list, and with good reason. While plastic is a general term for an organic polymer, most of them are excellent insulators, being as good as, or in some cases better than, the ceramic discs we see on high-voltage pylons. It's surprising, then, that an up-and-coming strand of electronics is concerned with electronic components that are made from plastic.

PVC, polythene and polystyrene might be familiar names, but they're only the tip of the iceberg when it comes to plastics. Because of the huge degree of flexibility in the way that atoms of carbon, hydrogen, oxygen and a handful of other elements can bond together to create the vast repeating molecules that we call polymers, there is an almost infinite number of possible plastics.

As with other areas of organic chemistry, creating new plastics can almost be thought of as designer chemistry, with scientists figuring out how to synthesise compounds with particular properties. In particular, chemists have discovered how to produce plastics that conduct electricity, a process that occurs for much the same reason that metals are conductors. Instead of being bound to a single atom, some electrons are able to migrate between atoms and, in so doing, are free to move significant distances when subjected to an electric field. It doesn't end with conducting polymers, either. Add in semiconducting polymers and we have everything needed to make the rather strange-sounding plastic transistor a reality.



↑ Plastic microprocessors might not be quick, but they're cheap and flexible

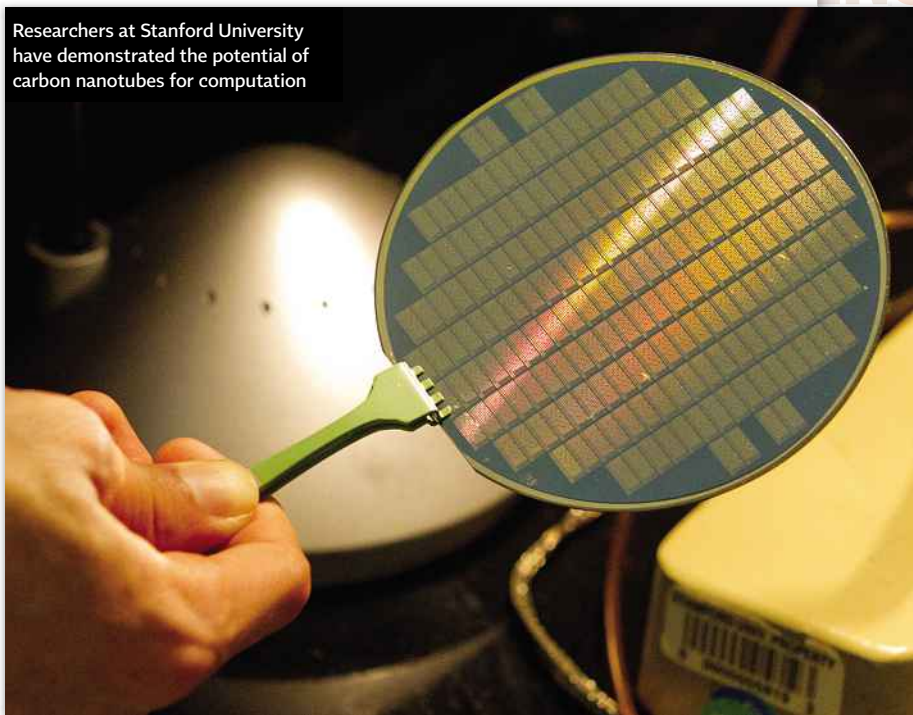
Unlike some technologies discussed here, plastic electronics has already made its impact. Plastic electronics feature in TVs and handheld devices that contain OLED displays. Organic logic circuits and even processors have been demonstrated but are in their infancy. Oddly, though, unlike most of the alternatives, rather than being a potential successor to silicon, polymer electronics doesn't match it in pure performance – it's not even close.

A few years ago, Imec, the Dutch microelectronic research centre, demonstrated the world's first plastic microprocessor. It was an 8-bit design and it operated at just 40 instructions per second, which is several billion times slower than silicon's latest and greatest. However, as Mike Banach, technical director of Cambridge-based plastic electronics pioneer Flexenable explained, this is missing the point of plastic electronics. "It's a complementary technology", he said, explaining that polymer circuits will often be used alongside silicon, each offering its unique benefits.

"Silicon offers higher performance and is more complex", he said. "Our solution provides more bespoke functions," alluding to the fact that low volume and fast turnaround products are far more feasible with plastics than with silicon. However, polymer-only circuits are also on the cards; indeed, our discussion covered areas such as simple wearable devices, and large-pixel displays or simple animations that could be produced so cheaply they could be incorporated into product packaging.

But is there a possible future for plastic electronics in high-performance circuits? Banach wouldn't be drawn on this question, and his reluctance to suggest that polymers might, one day, provide an alternative to silicon isn't at all surprising when we look at the figures. ➔

Researchers at Stanford University have demonstrated the potential of carbon nanotubes for computation



## PERHAPS IT'S NOT JUST SILICON APPROACHING THE END OF THE ROAD, BUT THE WHOLE CONCEPT OF THE ELECTRONIC SWITCH

Silicon has an electron mobility of  $1,400 \text{ cm}^2/\text{Vs}$ , as we mentioned earlier. By way of contrast, the first conductive polymers achieved a lowly  $0.05 \text{ cm}^2/\text{Vs}$ , and today's latest and greatest manages only  $23.7 \text{ cm}^2/\text{Vs}$ . Before being too dismissive, though, and bearing in mind that this is undoubtedly a simplistic analysis, this is an improvement of almost three orders of magnitude, and we don't need too many more similar improvements to put it ahead of silicon.

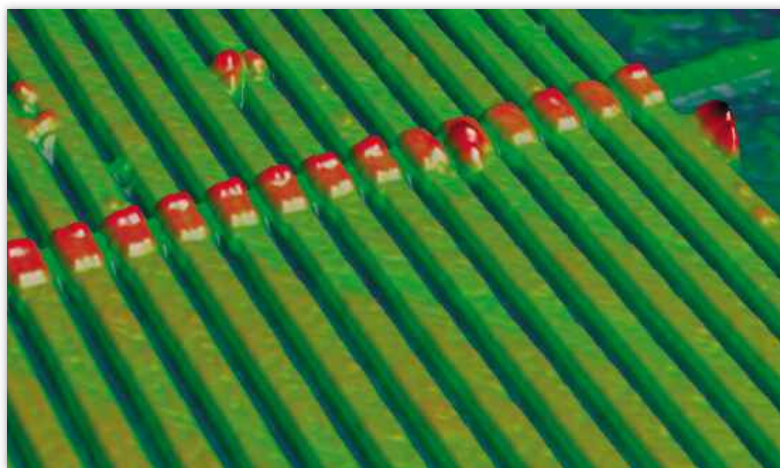
### MEMRISTORS

So far, our investigation of the new world of electronics hasn't strayed from transistors. For while the various materials we've encountered might be markedly different from silicon, all these weird and wonderful substances are being pressed into service as electronic switches. As we start to look at our final technology, though, we move into radically different territory.

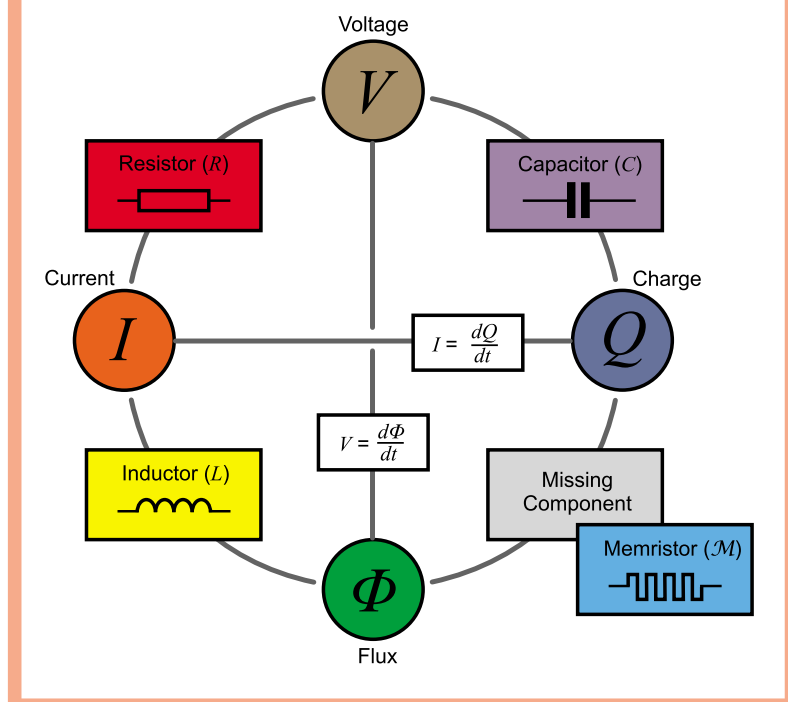
The memristor was discovered as recently as 2008 by a team at HP Labs, but its existence had been predicted for some time before that. Made from titanium dioxide, it's the fourth and final basic electronic element and takes its place alongside the resistor, capacitor and inductor. The name is a combination of the words memory and resistor and is very descriptive. A resistor is an electronic component that opposes the flow of an electrical current. Its resistance, that is the degree to which it opposes a current, remains constant. A memristor is also a type of resistor but there the similarity ends. If current passes through it in one direction, its resistance increases; if current flows in

↑ The memristor fills a logical gap in electronics between charge and flux, as this diagram shows

↓ In demonstrating the memristor, HP Labs not only used an unfamiliar substance, titanium dioxide, but opened up the possibility of a completely new electronics and computing paradigm



## THE MISSING LINK



the other direction, its resistance decreases. Because the resistance remains the same when no current flows, it can be thought of as a form of non-volatile memory but with a difference.

David Chalmers, HP chief technologist for EMA, explained the problem with today's memory. "It is now clear that our ability to continue the increases in density and reduction in cost that we have all come to expect from DRAM memory over the past 40 or so years are no longer sustainable. Put simply, DRAM works by putting electrons into a bucket. If there are lots in there, it's a one, if there are none it's a zero. Over the development cycles we have increased the capacity of DRAM by making the buckets smaller and smaller. However, we are now at the stage that the buckets are so small, we cannot reliably keep the electrons in place."

The answer, he suggested, is a non-volatile memory. "The solution set that is addressing this is the development of non-volatile memory (NVRAM). Essentially, storage technology that performs at approximately the performance level of today's memory... or should that be memory that stores data like a disk drive? Both are true. It's fast yet retains the data when the power is turned off."

Chalmers went on to explain that the memristor is the technology of choice. "There are a number of approaches to making commercial NVRAM, and HP sees the memristor as the one with by far the most promise. It works, it has approximately the same performance as DRAM, it can be manufactured without the use of highly exotic materials and processes, and it has excellent longevity. It achieves this by using not electrons but ions as the basic building component. They are larger, much better behaved, can be manipulated by relatively simple electric fields, and they stay where you put them. Five years ago we could see the new generations of demand and challenge coming, but we were uncertain how to address them. Today, with the development of



the memristor and its many accompanying new approaches to building infrastructure, we can see how to create new levels and generations of infrastructure that will allow us to ask the really interesting questions”.

So the memristor is first and foremost a memory technology, but one that could have a huge impact on computing. By eliminating the need for a memory hierarchy, usually comprising expensive, fast, volatile memory and cheap, slow, non-volatile disk storage, totally new computing paradigms become possible, even if the processing is still silicon-based. Other researchers believe the memristor is a more universal technology and have even proposed means by which it could perform computations as well as storing data. Perhaps it's not just silicon that's approaching the end of the road, but the whole concept of the electronic switch.

### A DECADE OF QUESTIONS

We've long known that, when it comes to the future of computing, making predictions is a sure-fire way of ending up with egg on your face. In this article we've

examined the most promising technologies that are currently exercising the minds of the world's leading research scientists. One or more of them might just end up at the core of our computing devices in a decade or two's time, but there are no guarantees. Scientists might still find ways of pushing silicon yet further – or some other technology, as yet undreamed of, might take the limelight.

Given their early stages of development it's hard to imagine any of them ever achieving what the silicon chip has done for us over the past 40 years. However, even the silicon chip started from humble beginnings and look how ubiquitous it is today; surely it's up there with the invention of the wheel or irrigation in just how much it's changed our world.

We can't resist one little prediction, though. Experts are suggesting that silicon has little more than another decade's development to look forward to. Nevertheless, we predict that future generations will not be looking at the year 2025, remembering the date at which the electronic adventure came to a grinding halt. ☐



## A TRIP DOWN MEMORY LANE

While this article is focused on the future, a look back to the time before silicon transistors will illustrate how massive a difference can be brought about by a new generation of electronic device.

The most fundamental building block in digital electronics is the electronic switch, a component that allows a current or voltage in one circuit to control the flow of current in another. The electronic switch was invented in 1906 by Lee de Forest. It was called the triode valve and was initially used as an analogue amplifier, thereby enabling radio signals to carry voice transmissions for the first time, and a variant was used to power the first ever electronic computers 40 years later.

Today's electronic circuits are referred to as 'solid state' because their operation involves the flow of an electrical current through a solid substance, namely silicon. Valves were different because they worked using an electric current flowing through a vacuum. The triode valve had a cylindrical cathode that was housed in a glass envelope from which the air had been removed. The cathode was coated with metal oxides and emitted electrons when it was heated by an electrical filament inside the cylinder.

When a high voltage was applied to another cylindrical electrode, called the anode, surrounding the cathode, the

negatively charged electrons were attracted to the anode so an electrical current flowed through the vacuum. However, things were complicated by a spiral of wire, called the grid, which was wound in the space between the anode and cathode.

By applying a small negative voltage to the grid, electrons were repelled, thereby preventing the flow of current between the anode and cathode. This, then, was an electronic switch, and all later valve developments such as the tetrode and the pentode were variations on the theme.

Perhaps surprisingly, speed isn't the main benefit that silicon transistors offered over valves; indeed, specialised valves are still used for some high-speed communication applications. However, a few facts and figures make it abundantly clear why valves were pensioned off in favour of solid-state circuits.

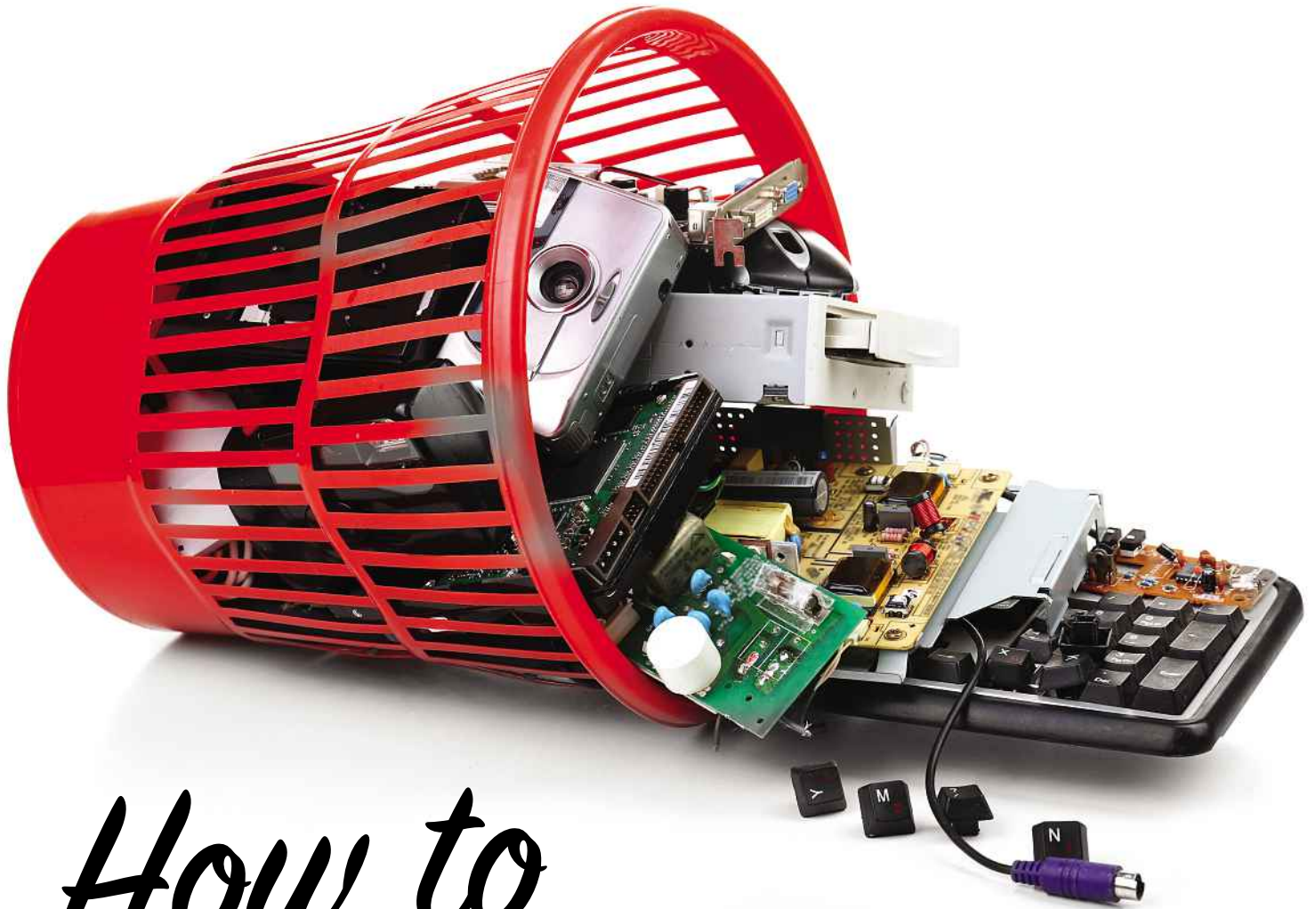
Because of that heating element, valves were power-hungry, consuming around 1W. The valve equivalent of a four-billion transistor processor would therefore have to be powered by a couple of large power stations. They're not exactly small, either. That same processor would occupy a 200m cube if it was built from valves, even if we assume they were tightly packed and that no other components were needed. Such a



Valves might be almost forgotten but, before silicon, they powered all our electronic devices

structure would be a similar height to several of London's tallest buildings, but it would have a much larger footprint.

Finally, they're not too reliable. ENIAC, the world's first electronic computer, contained just 17,000 valves but it broke down every two days. Finding the offending valve reportedly took an average of 15 minutes.



# *How to* **PROPERLY GET RID OF YOUR OLD TECH**

Old pieces of tech shouldn't just be left out for the binmen. Our guide will help you dispose of unwanted kit the right way

**W**hile many of us are getting our PCs and laptops ready for the free Windows 10 upgrade, many will also have ageing PCs around the home which simply won't make the step up. If you're unlucky it could be your main laptop that needs replacing, or it might simply be time to finally retire that old PC lingering in the study. Either way, we'll explain the best way to get rid of old hardware responsibly and safely – whether it's a PC or something more domestic.

Windows XP and Vista PCs are getting on now, although you may still find a use for them. They could, for instance, be pressed into service as a DIY network-attached storage (NAS) device or as a Plex server that delivers your media to the rest of your networked systems and devices. However, for many this will simply be more hassle than it's worth, and although we're keen on such projects you should ensure you have a definite computing need rather than simply a hoarding instinct.

Even Windows 7 PCs that are due the free upgrade may have had their day: the operating system was originally released in 2009, which in tech terms is a lifetime ago. Microsoft has said you'll only be offered the free Windows 10 upgrade if your system will deliver a 'great experience', which means a number of us will be out of luck when it comes to the free upgrade because of slow or incompatible hardware.

Whatever the reason for junking your old kit, read our guide before hurling it in the bin.



# Getting rid of PCs

The first priority will be wiping the system so none of your sensitive information is still on the storage disk(s). Windows Vista, Windows 7 and Windows 8 all make returning your system to its factory default condition a relatively straightforward process, although the steps for each are different.

With Windows Vista and 7 your restore options might be dependent on your PC or laptop manufacturer, as some provide recovery images on a disc or restore partitions on the hard disk. You might find you need your original operating system disc.

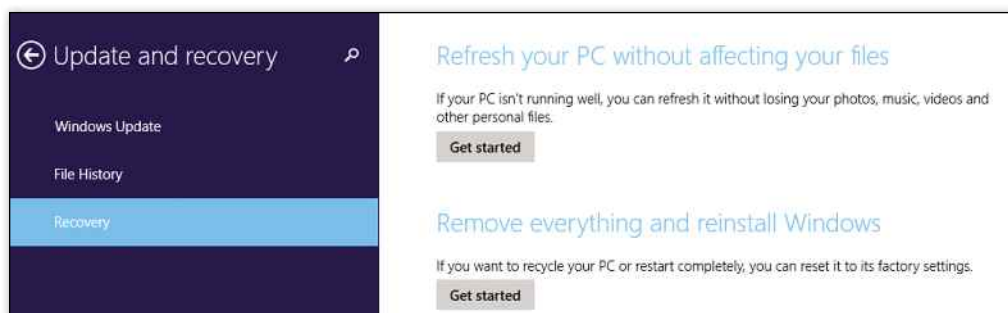
Before embarking on a factory restore, be sure to back up any important data first. There's no going back and recovering it once a factory restore is done. If you do have secondary hard disks installed, be sure to back up and delete anything stored on them manually, as a Windows factory restore will only affect your main system drive. For a desktop PC, consider transplanting your storage disks to a newer system, although usually this is pointless and you're better off moving the data off the ageing drive.

Here's how to wipe your PC for each Windows operating system.

## Windows Vista

You'll need to get into the Advanced Boot Options menu as your computer starts up. The easiest way is to immediately start hammering the F8 key as soon as you hit the power button. You'll be presented with a text menu where you'll see 'Repair Your Computer', which is the option you're after.

Proceed by selecting your language and entering your Windows Vista username and



Make sure you wipe your PC of all its data before you get rid of it

password. Now select 'Windows Complete PC Restore'. Choose to use the latest available backup and hit Next. Make sure you tick the 'Format and repartition disks' box before clicking Next again.

After it's done, all your content should be wiped and Windows Vista will run as if it were brand new again.

## Windows 7

Open the Control Panel in Windows and select Backup and Restore. Under the Restore section, click on 'Restore system settings or your computer'. Now you'll want 'Advanced Recovery Methods'. Finally, select 'Reinstall Windows (requires Windows installation disc)'. You'll be asked if you want to back up anything, but you can skip this if you've already backed up your important files. After a restart your computer will be like new.

## Windows 8

Windows 8 is simple to restore to its original state. Just go into PC Settings and select 'Update and recover'. You'll then need to select Recover from the side menu. One of the options is 'Remove everything and reinstall Windows'; select this option, click

'Get started' and the process of restoring to the PC's factory default condition will begin.

## Data-wiping software

You can also use data-wiping software to completely obliterate the contents of your computer's hard disk or SSD. If you have sensitive information on your PC then this is probably worthwhile, but be realistic: it's unlikely someone will haul your PC out of the bin and spend hours sifting through the deleted files on your disc in the hope of gleaming your Amazon password.

Data wiping will also remove the operating system, which is worth keeping in mind if you're intending to pass the PC or laptop on to someone else to use. If you're giving it to a family member or friend, it will be worth going through the factory-restore process described above in order to leave them with a working system at the end.

If you have decided to wipe your storage, there are software packages such as DBAN ([www.dban.org](http://www.dban.org)) that will wipe the contents of a hard disk. If you're wiping an SSD, it's advisable to use the software provided by your SSD's manufacturer to wipe the data safely without damaging the drive.

# Don't bin your computer!

Now you've successfully wiped your data, it's safe to get rid of your old computer. However, the worst thing you could do is consign it to landfill. Not only is this bad for the environment, but there are plenty of ways your dated system can be recycled or found a new home where it can still be appreciated.

## Donate it or recycle it

The most obvious way to find a new home for your old PC is to donate it. Most people have a friend or relative who don't need the latest cutting-edge technology and can still get some joy from an old system, so see if someone else can make use of it.

Otherwise, contact your local council to see if there are any recycling schemes for donated technology. Libraries and schools can often find innovative new uses for old systems, and they can provide useful

educational tools. Try [www.recyclenow.com/recycling-locator](http://www.recyclenow.com/recycling-locator) or contact your local council via [www.gov.uk/find-your-local-council](http://www.gov.uk/find-your-local-council).

Some local councils run volunteering and training schemes for recycling old technology. These provide valuable hands-on experience for local community members and can be a gateway to employment for those struggling to find work. Repaired products are often sold on to help fund council schemes, so you'll be doing your part for your local community.

Plenty of charities accept old PCs and laptops and put them to good use, both at home and abroad. Companies such as CFC ([www.computersforcharities.org](http://www.computersforcharities.org)), Computer Aid International ([www.computeraid.org](http://www.computeraid.org)) and UK IT Recycling ([www.ukitrecycling.com](http://www.ukitrecycling.com)) offer to wipe your data but it's still worth doing this yourself beforehand for added peace of mind.

Manufacturer recycling schemes are another option. Companies such as Dell,

Apple, HP, Sony and Lenovo all offer recycling schemes for their old products. Some firms even accept products from rival brands for recycling, which can be a good way to unload an unwanted old system.

## Sell it

There are of course also plenty of avenues for you to recoup some of the original cost of the system if it's still worth selling. High street stores such as CEX buy old systems, and you can always try to sell your system on an online marketplace such as eBay; and don't forget the humble car-boot sale.

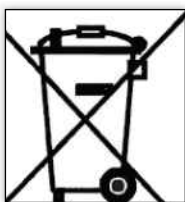
Some manufacturer recycle schemes will give you store credit for products you recycle, so it's always worth checking if they have some sort of buy-back scheme when you decide to upgrade. The important thing is not just to throw out your PC or laptop with the rubbish.

# Getting rid of other old tech

The same principle applies to disposing of your other items of technology you may have lying around the house, whether they're large household appliances or smaller items such as cameras or mobile phones: don't simply throw them out with your household waste to end up in landfill.

Waste Electrical and Electronic Equipment (WEEE) is a massive problem, with an estimated two million tonnes of WEEE items and materials discarded each year in the UK. Often these are the types of items that need to be disposed of in a considered manner and not just thrown out.

Since 2007, WEEE regulations have been in place to try to reduce the amount of untreated WEEE items ending up in landfill. Electronics retailers must offer a way to dispose of old items when they sell you a replacement, so ask when buying (though they may charge for this service). Retailers such as Currys will display a crossed-out wheelie bin symbol on products that should be recycled. Again, it's worth trying [www.recyclenow.com/recycling-locator](http://www.recyclenow.com/recycling-locator) to find nearby recycling centres.



## Mobile phones

It's not uncommon for people to upgrade their mobile phone every couple of years, depending on their contract. This means you may well have a drawer of old handsets and chargers that are well past their best. Like a PC or laptop, there might be someone you know who'll be glad to receive an older phone, or you might also be able to sell your handset to stores such as CEX, on eBay, or via sites such as [www.compareandrecycle.co.uk](http://www.compareandrecycle.co.uk).



◆ You can safely dispose of old printer cartridges and earn Clubcard points at The Recycling Factory

If your old mobile is really not worth selling or giving away, it might still be very valuable to others. Charities such as Water Aid and Oxfam can benefit monetarily from every mobile phone you recycle and use services such as Fonebank ([www.fonebank.com](http://www.fonebank.com)) to make it easy for you to do so. You can decide what percentage of the mobile phone's value goes to charity all the way up to 100% if you want. Visit your chosen charity of choice's website to see what your options are.

## Store recycling

High-street electronic stores such as Currys will accept smaller household electrical products for recycling if you bring them in, even if they weren't bought at the store. This is a convenient option for smaller items you want to get rid of responsibly.

If you're buying a larger household appliance, most retailers will offer a product-recycling service alongside delivery of your new product. This means they'll take away your old fridge or washing machine and recycle it properly. Collection might incur a charge, however. If you're having a television installed, it's worth keeping in mind that today's Smart TVs can often have personal data on them, so be sure to factory-restore them before you have them collected just like a PC.

## Manufacturer recycling

It's worth looking to see if the manufacturer of the product you want to dispose of has a recycling scheme. Like PC and laptop manufacturers, many electronics companies will happily take back their old products for recycling. These include Acer, Canon, Dyson, Nintendo and Microsoft.

## Give it away!

Websites such as Freecycle ([uk.freecycle.org](http://uk.freecycle.org)) and Freegle ([www.ilovefreegle.org](http://www.ilovefreegle.org)) make it easy to find your old gadgets a new home. You can also give away other items such as furniture, too, so there's no reason to throw anything away.

## Batteries and printer cartridges

One of the biggest concerns with throwing out old pieces of technology is the batteries that are often left inside them. Batteries contain harmful chemicals, including many heavy metals including mercury or cadmium. The rubbish compactors at your landfill don't discern between waste products, so that battery is going to get crushed, causing those chemicals to be released into the air.

These chemicals are not only harmful to the environment but also to wildlife through soil and water contamination. Batteries can also take hundreds of years to decompose, meaning they'll just sit in landfill. Properly recycling devices that contain Lithium Ion or Lithium Polymer batteries is therefore crucial.


If you're looking to dispose of batteries by themselves, such as the common AA or AAA batteries in your TV remote control, you'll find recycling points in most electronic stores or supermarkets. Like recycling old clothes or plastic bags, just pop them in the recycling repository and they'll be recycled responsibly.

Printer cartridges are another considerable source of landfill waste. Throwing them away is a waste as they can be easily refilled and re-used, or the entire cartridge properly broken down to be recycled. Many retailers, such as PC World or Staples, allow you to drop off used ink cartridges for recycling. Occasionally this will also earn you a discount on new cartridges as well.

Tesco also rewards you for recycling your cartridges through its Recycling Factory service ([www.therecyclingfactory.com](http://www.therecyclingfactory.com)), which provides Clubcard points in exchange for your old cartridges. The monetary value of the Clubcard points can also be donated to charity instead if you prefer. There's a limit of 100 inkjet cartridges per household, but we doubt many homes will ever get anywhere near that limit. Laser-printer toners can also be recycled, so check if your workplace is disposing of its used toners properly.

The best way to reduce the number of printer cartridges being disposed of is, of course, to print less. So consider whether that hilarious cat photo needs to be printed before hitting the button. ☑

**MAKE A DONATION TO OXFAM**



Making a donation to Oxfam with Fonebank is easy. We turn every mobile phone donation into cash for Oxfam to buy vital kit, such as water tanks, wells, tools, seeds, school books - and loads more.

**Sell & Donate to Oxfam Now**

**How Do I Donate The Value Of My Mobile Phone To Oxfam?**

**Step 1.** Simply click the 'Sell And Donate' button above.

**Step 2.** Add your mobile phones to the cart and check out.

**Step 3.** Login with your regular Fonebank details or create an account if you are new to Fonebank.

**Step 4.** You will be given an option to donate 100% of the value of your mobile phones to Oxfam. Alternatively, you can opt to donate 25%, 50% or 75% instead and any balance due to you will be paid by cheque or BACS as selected and your Oxfam donation will automatically be sent to Oxfam.


Please click here to see the impact of Oxfam's work and how your donation could help

**Start Donating to Oxfam Now**

**Search**



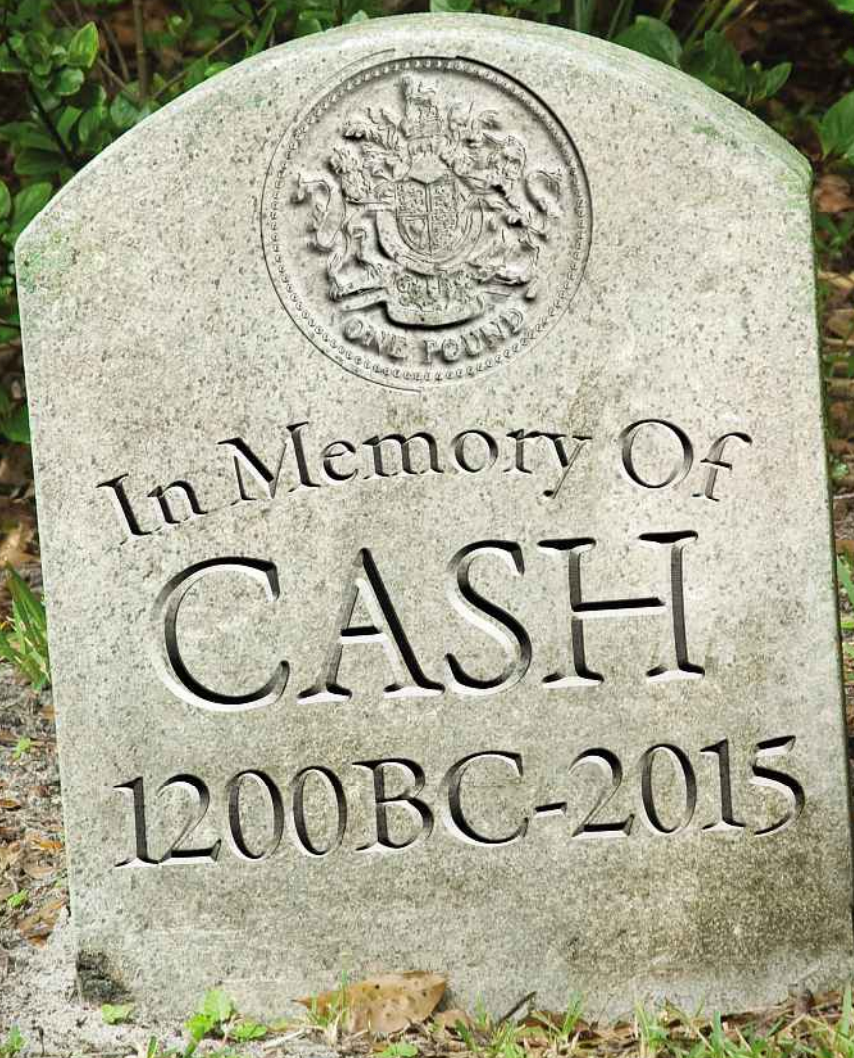
AN UNWANTED PHONE, WORTH £50, COULD PROVIDE SAFE WATER FOR 50 PEOPLE. £50 helps set up or maintain a safe water supply with pumps, tanks or purification systems.



**A PERCENTAGE FOR OXFAM, A PERCENTAGE FOR YOU!**

◆ Donate your old mobile phone rather than throwing it away





# THE DEATH OF CASH

Apple Pay and bPay are now available in the UK. But how do they work? And could they spell the end for traditional payment methods?

**O**ne of the big new features of iOS 8 and the iPhone 6 and iPhone 6 Plus, Apple Pay, the company's own payments system, is now available in the UK. Arguably it will have a bigger impact here than it did in the US, as many of our stores have the contactless payment terminals required by the system. Here's everything you need to know about Apple Pay, including how to get it, how to use it and its limitations.

## **Q What is Apple Pay and how does it work?**

Apple Pay lets you use your iPhone to pay for goods and services. It can be used in any shop with an NFC contactless card reader, and for in-app purchases. To fund your purchases, you have to store your existing credit and debit cards in Passbook (to be called Wallet in iOS 9), and money is taken out of these

accounts. It's similar to how PayPal works: you pay for goods using PayPal, but the money is debited from your linked accounts; however, Apple Pay is more flexible, as it works in the real world in a larger number of shops.

## **Q Is it safe to use?**

Completely. In fact, it's arguably safer than using your real credit card. Rather than storing your credit card details, a unique Device Account Number is assigned, encrypted and saved in the Secure Element chip in the iPhone, iPad and Apple Watch. When you make a purchase, your Device Account Number is used in conjunction with a transaction-specific code, so you never reveal your credit card's full details. This means your card can't be cloned by a dodgy shop.

Transactions are also protected by Touch ID, which means they're made in a secure way. This is an improvement on normal contactless

payment, where there's no security: anyone with your credit card can make a payment. Using the Apple Watch doesn't require your fingerprint, but the Watch has to be paired to your phone. In other words, if somebody wanted to use your Apple Pay account, they'd have to steal your phone and your Watch and keep them in pairing distance.

In addition, if your phone is lost or stolen, you can use Find My iPhone to turn off Apple Pay, so your phone can't be used to pay for anything. And you don't have to cancel your cards, as they can't be used via Apple Pay.

## **Q Do I need a data connection?**








As Apple Pay stores a secure transaction token on your phone or Watch, you don't need a data connection to use them. This means you can use them when you don't have service, such as when you're on the Tube, or when you're abroad without



running up a huge roaming bill. It also means you can take the Apple Watch out on its own and pay for goods without your phone.

## Q Which devices support Apple Pay?

You can use a variety of different devices with Apple Pay, although some of them are limited to in-app purchases. The table below shows you what you can do with each device:

PRODUCTS		APPS	IN STORES
iPhone 6 iPhone 6 Plus			
Apple Watch Paired with iPhone 5s, iPhone 5c, iPhone 5s, iPhone 6 or iPhone 6 Plus			
iPad Air 2 iPad mini 3			

↑ The type of Apple device you have determines how and where you can use Apple Pay

## Q What's the transaction limit?

While normal contactless payments have a transaction limit of £20 (rising to £30 in September 2015), Apple Pay shouldn't have any limits, as the transactions are more secure and have to be authenticated. "There is no transaction limit," Visa told us. "This is because the authentication acts similarly to PIN." However, the reality is that contactless terminals are set to allow a maximum transaction of £20. For higher limits to apply, it will require retailers to support Apple Pay and increase the amount that can be spent. That means that most people will encounter a £20 cap at launch, though

some stores will increase the limit after launch; Pret a Manger already offers unlimited transactions.

## Q Where can I use Apple Pay?

As we said, it works with any shop that has a contactless card reader, even those that don't directly support it, such as Tesco and Sainsbury's. This is because Apple Pay uses the normal contactless system. Higher limits, as we said above, will need to be supported in-store. Companies that have signed up to Apple Pay include Waitrose, Marks & Spencer, BP, Dune, Boots and Wagamama. You can also use it on the Tube. Apple says 250,000 locations in the UK will initially support Apple Pay, but expect this number to grow rapidly.

## Q Are there any other restrictions?

It depends on the store, but if you're using standard contactless terminals that haven't been upgraded specifically for Apple Pay, you can get hit with a request to verify the payment by inserting the original card and entering your PIN. We had this in our local Co-op, and had to open our wallet and go through the

➔ You can use your phone's camera to read your credit card details automatically



➔ Look out for the Apple Pay or Contactless symbols if you want to pay with your phone

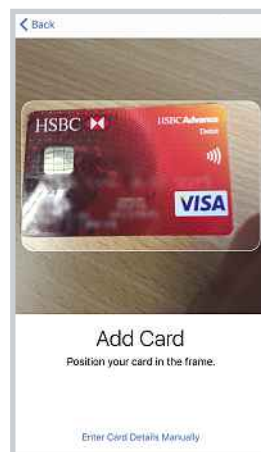
standard payment process. Admittedly, this kind of request happens infrequently and, as more shops upgrade to full Apple Pay support, won't be a problem.

## Q Will it change how we pay?

Not right now, as you'll still need a physical card to pay for things in some shops and to withdraw cash, but it's a step in the right direction and more convenient than using traditional contactless and cash.

## Using Apple Pay

First, you need to associate at least one card with your Apple Pay account, which can be a debit or credit card. The card's issuer must support Apple Pay. Most UK banks do, although Barclays, Halifax and HSBC will launch later, while Mastercard, Visa and American Express all support it. To use Apple Pay in store, you need a shop that has a contactless card reader and a device with an NFC chip in it (iPhone 6, iPhone 6 Plus or the Apple Watch). The store must also support the credit card type that you're trying to use: you can't use American Express, for example, in a shop that doesn't normally take it.



# Is bPay a viable alternative to Apple Pay?

There's a reason why Barclays was the only major bank not to commit to Apple Pay at the start (although it has now said it will bring the system to customers): it had a revamp of its own cashless payments system up its sleeve. Literally. The new bPay system includes a range of three payment devices: a wristband to tuck under your shirt sleeve, a keyring fob and a sticker than can be affixed to the back of a mobile phone, effectively turning any phone (smart or not) into a cashless payment device.

Is it more convenient than cash or card? Does it have any advantages over Apple Pay and other cashless payment systems? We've been testing the devices to find out.

## How to set up bPay

To begin using bPay, you need to buy one or more of the three available devices. The wristband is the most expensive, costing £25 from the bPay shop. Next comes the keyring fob, which costs £20, and cheapest of all is the sticker – which can be affixed to almost anything with a flat surface or even tucked into a wallet or purse – for £15.

The wristband and the fob are supplied with a chip, which is the same size as a mobile phone SIM card. You pop the chip into the wristband/keyring fob, which is a bit of a fiddly process, although there's little chance of that potentially valuable

It's easy to set up and register your bPay account using the mobile apps for iPhone and Android



chip falling out of either device. The sticker has all the necessary circuitry built in.

You then have to download the bPay app for your iOS or Android smartphone to register the devices and load them with money. You can set up an account via the bPay website if, say, you're a Windows Phone user, but the mobile apps are definitely more convenient.

Setup is painless. You need to register an email address and select a five-digit passcode. Our only gripe is that, on Android, the app uses its own software keyboard (presumably in order to prevent sensitive data being captured by rogue keyboard apps), which displayed notable lag in our tests.

You then need to top up the bPay wallet before you can start using the device for payments. You can use any Visa or Mastercard credit or debit card to top up the wallet, up to a maximum of £200. You don't need to be an existing Barclaycard customer. One notable irritation is that if you use more than one bPay device, each must have a separate 'wallet', meaning each device must be topped up separately. The wristband and key fob can't draw funds from the same pool of cash, which we think is pretty daft.

## Using bPay

Using the bPay devices is also painless. Any retailer that supports contactless payments can accept bPay devices, including Waitrose, WH Smith, Marks & Spencer and numerous other high-street chains. Londoners can also



## HOW TO add a credit card to Apple Pay on an iPhone or iPad

To add a credit card to your iPhone or iPad, you need to launch Passbook. Tap the '+' icon next to Apple Pay to add a new card and click Next. You can now use your phone's camera to line up the onscreen window with your credit card and the long number and expiry date will be read automatically.

Tap Next to continue and enter your name as it appears on the card, then tap Next. You'll now need to enter your card's security number (the three digits on the back of a Visa/Mastercard, or the four digits on the front of an American Express card). If the camera couldn't read the expiry date, you can enter it manually. Tap Next and you may be prompted to authenticate your card, either by a code sent to your phone or by calling the card issuer. Once done, it will take a few

minutes for the card to be activated for use, and you'll be prompted when it's ready.

You can repeat these steps to add as many cards as you like. To set one as the default, go to Settings, Passbook & Apple Pay (Wallet & Apple Pay in iOS 9) and tap the Default button. You can now choose which card you want to use as your default payment method.

## HOW TO add a card to Apple Pay on the Apple Watch

If you have an Apple Watch, you have to add your card to the Watch, because the Apple Watch can be used independently. To add a card, open up the Watch app on your phone and then tap Passbook (Wallet in iOS 9). All the cards you've added to your phone will be listed here, so tap Add next to the ones that you want to add to your Watch. You'll need to enter the card's security number and you may have to go through the same authentication (text message or phone call). If you want to add a card to your Watch only, tap Add Different Credit or Debit Card and then follow the iPhone instructions above.

## HOW TO use Apple Pay in store (iPhone)

To use your default card, hold your finger over the Touch ID sensor (don't click the home button) and hold your iPhone over the contactless terminal. The payment will be authenticated immediately. If you want to use a different card, hold your iPhone up to the reader to bring up the Apple Pay screen. Swipe left and right to choose the card you want to pay with and then hold your finger over Touch ID (don't click) to pay.



## HOW TO use Apple Pay in store (Watch)

Using the Watch to pay in store is simple. Double-tap the side button (just below the Digital Crown) to bring up your default credit card. If you want to select a different card, just swipe left or right. Finally, hold your Watch up to the contactless terminal and the transaction will be confirmed.

## HOW TO use Apple Pay in app

If you want to use Apple Pay in a supported app, you have to have an iPhone 6, iPhone 6 Plus or iPad Air 2. When you get through the payment option screen, select Apple Pay. You can choose your credit card from the list (not all are activated for in-app transactions), and you may have to fill out some details the first time you use it (billing address, delivery address, phone number and so on). When everything's ready, just hold your finger up to Touch ID and you're away.



use the devices as pseudo-Oyster cards, allowing them to touch in and out on journeys across the Tube network without having to queue up for a ticket. You can register the device on the Transport for London website ([www.tfl.gov.uk](http://www.tfl.gov.uk)) to track journeys, although you don't have to. Note that bPay devices can only be used for individual full-price journeys, not season tickets or any concessionary fares.

We did get a funny look from the cashier in McDonald's when we slapped a wristband against the payment device, but she soon got over it. The sticker on the back of the smartphone is by far the least conspicuous of the bPay devices, and the one you're least likely to lose, break or forget. We had to affix ours to the inside of the smartphone's case, as the curved back on our HTC One didn't provide the necessary flat surface.

The accompanying mobile app keeps track of payments and your current balance, and it's updated the instant you make a purchase. The automatic top-up feature is both handy and dangerous, as it allows the app to draw down more money from your credit/debit card the moment you pass a certain balance threshold. Your payment will be rejected if you don't have enough money in the account to cover a purchase.

↓ The wristband is the most expensive device, but arguably the most useful



## bPay: our verdict

Will we continue to pay for goods using our bPay devices? To be frank, we're not sure it's worth the bother. It doesn't offer any real advantage over a contactless debit card that most banks now issue by default, and has several key downsides. First, you're stuck if the retailer doesn't offer contactless payments, whereas contactless cards can also be used in regular chip-and-pin readers. The £20 transaction limit that applies to any contactless payment device is another drawback, because unless you're only popping out for a sandwich or another small item, you'll need cards or cash with you anyway.

Apple Pay is currently hamstrung by the same restrictions, but once retailers start using Apple Pay terminals, customers will be able to authenticate their payments using the fingerprint reader on their iPhone and exceed the £20 limit, making it a viable alternative to cash.

The only way we could see bPay being used regularly is as a pocket money system for children. You could give the kids a key fob, load it up with £20 and let them loose in the shops, safe in the knowledge they can't overspend. It's less likely to be stolen than cash, and if the bPay device is mislaid or swiped, you can cancel it and stop any future payments. A bPay spokesperson told us there is nothing to prevent parents issuing bPay devices to their children, whereas it would break bank terms and conditions (not to mention all common sense) to give the kids your regular contactless payment card.

In short, bPay is an over-engineered solution to a problem that doesn't exist. The idea of issuing kids with a pre-paid payment device does have appeal, but it's not worth the hassle for grown-ups. **CS**



# Taming Android and iOS

We show you how to make your smartphone and tablet easier to use

**GETTING YOUR HEAD** around the latest technology can test even us. In a world where technological innovation feels like a daily occurrence, it's easy to slip behind the curve. For some, such as the older generation or the physically impaired, it's tougher still.

Touchscreen interfaces in particular don't come naturally to everyone. This is particularly true if you've just got started, as such devices are now far more complex than when the first iPhone was

launched in 2007. In a way, the gestures and inputs we're used to are learned like languages, so using tablets and smartphones can be a distinctly foreign experience for some.

Thankfully, there are numerous ways to make getting to grips with Android and iOS devices much easier. These range from built-in operating system functionality through to apps and launchers. Here we guide you towards a simpler smartphone and tablet experience.

## ANDROID

### Accessibility options

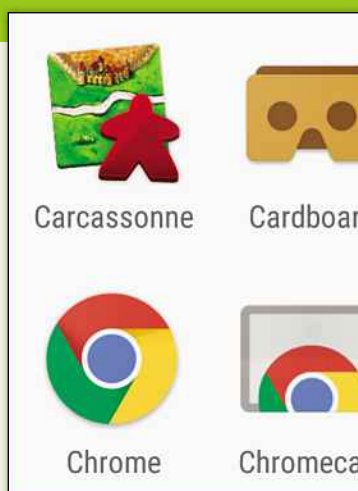
Android has plenty of built-in accessibility functions to make navigation easier. These are all accessible from the Settings app under Accessibility. Some of the following options might not be available in every version of Android, but most of them should. We've used the latest version, Android Lollipop.



Android has a TalkBack feature, which provides spoken feedback for onscreen items and can use your smartphone or tablet's vibrations to assist navigation for vision-impaired users. When you first turn it on there's a useful tutorial that takes you through the numerous gestures available through the feature, which is worth studying as it can still be a little complicated at first.

For those with impaired vision, turning on Magnification Gestures enables you to triple-tap the screen to get a zoomed-in view. Annoyingly, though, there's no way to adjust the timings for double or

TalkBack highlights and reads screen elements



Magnification can make it much easier to read text or click small icons

triple taps in Android. While zoomed in you can use pinch gestures to zoom in or out and a two-finger drag to pan around the screen, which makes hitting smaller icons or links much easier.

Turning on the Large Text setting will increase font size for app labels across the operating system. Unfortunately it doesn't apply to the fonts in every app; when we tried it, Twitter had larger fonts but the Facebook app remained the same. You can also turn on colour inversion, which might make viewing the screen easier for some users.



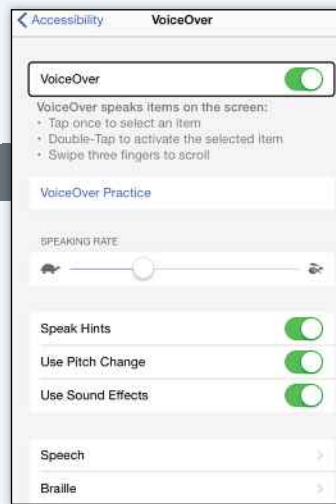
## iOS

## Accessibility options

Apple's iOS is an easy-to-use operating system, which has made iPhones and iPads a popular choice for the inexperienced. There are, however, plenty of ways to make it even more approachable through the Accessibility options. These are available in the Settings app under General, Accessibility.

From here you have a number of useful accessibility features. Larger Text lets you adjust the font sizes used throughout iOS and will also apply to apps that use Dynamic Type, such as Twitter. Annoyingly, though, not all apps support Dynamic Type, as some have their own built-in font size settings.

The built-in zoom lets you double-tap three fingers on the screen to give an



There are lots of ways to customise iOS's VoiceOver

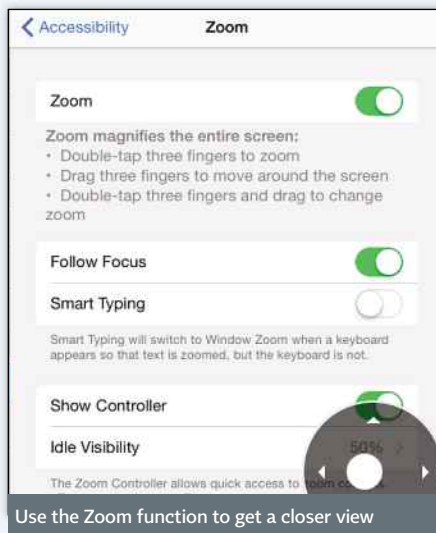
enhanced view, which can make reading or selecting small icons and links easier. You can adjust zoom levels

or pan around a zoomed-in screen with gestures and choose between full-screen or windowed modes. If the gestures are a bit daunting, a Show Controller option puts a little joystick-like interface on the screen permanently, which you may find easier to use.

VoiceOver can read out onscreen items, aiding you with navigation. Tap an item on the screen and the VoiceOver function will read

out a description rather than activating them. A double-tap instead operates as a regular touch input to open apps or links in Safari. Other settings in the Speech menu include the option to turn on the Speak Screen setting, which will read the entire contents of a screen when you swipe down with two fingers.

iOS is full of fancy effects and animations, such as the parallax effects on icons and alerts, but these aren't always conducive to ease of use for those with poor eyesight. Fortunately, most of them can be disabled in the Accessibility, Reduce Motion menu. You



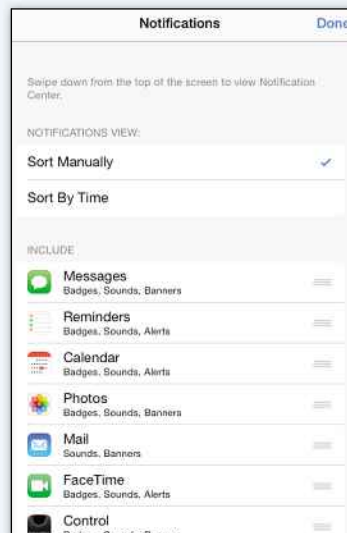
can also reduce transparency effects and darken or turn down the intensity of colours in the Increase Contrast settings.

You can also adjust the speed required to activate the Home button double-press, which will be a great help for the less nimble fingered.

## Organisation and notifications

Once you start installing apps, the iOS home screen can quickly become a mess of icons that can make it difficult for users to remember where things are located. Organise your apps by putting them in folders with easy to understand labels such as Photos or Reading so it's easier to find what you need. Even then, all the folders and icons can still seem a bit daunting, but you can move your most important apps to the first Home screen so they're always easily accessible.

Having the constant distraction of app notifications popping up can also be intimidating as it can quickly become overwhelming. You can stop your iPhone or iPad being inundated with notifications by going to the Notifications section in the Settings app. Move all but the most important apps, such as Messages, to the Do Not Include section.



Disabling unnecessary notifications can make using your iOS device less daunting

## Custom launchers and keyboards

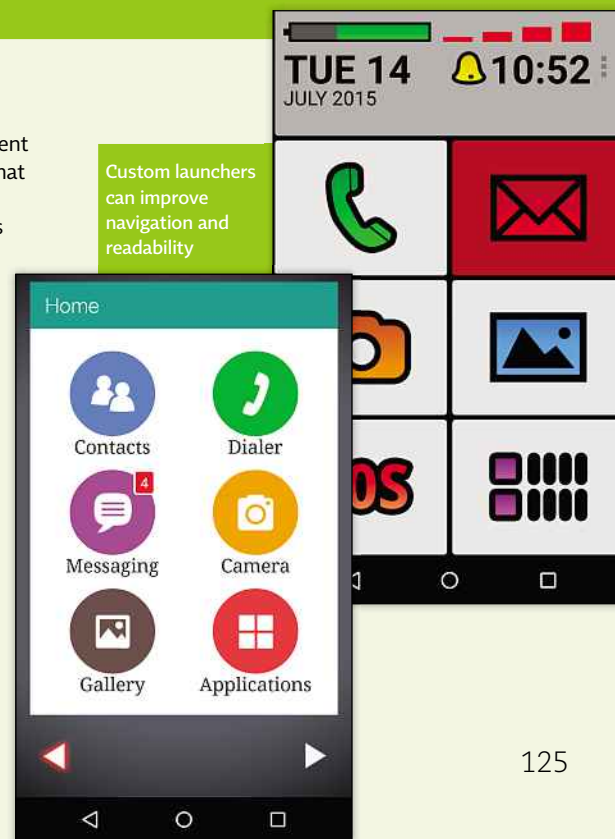
One advantage Android has over iOS is the use of custom launchers. These can be considered as a way of customising the look and feel of parts of the Android operating system, such as menus and the app drawer. This is important for accessibility as it means there are launchers designed specifically with ease of use and accessibility in mind.

Some launchers, such as BIG Launcher (£7.50), make navigation easier by providing a large icon interface that can be easily customised. This means you can set up your Android device with only the essential apps, which are then within easy reach. It's also a good way to restrict navigation so users don't get lost in the Android interface. You can even customise an SOS button that can be set to text or call a specific number in the case of an emergency, which may help provide peace of mind. The big, bold colours can also be customised with different themes.

The free Wiser – Simple Launcher functions in a similar way, but is arguably more attractive. It's broken into four different customisable tabs, including a Home tab that contains your most commonly used apps. Unfortunately the messaging app launches the default messaging app, unlike BIG Launcher, which has its own app. If you do change your launcher, make sure you set it to always launch so it becomes your default launcher by going to the Settings app and then Home.

It's also a good idea to pair a custom launcher with a custom keyboard that will make text input easier. Most default Android keyboards aren't always easy to use for those with poor eyesight or motor control. Options such as Big Buttons Keyboard (£1.87) make viewing and hitting the correct key easier, although its slightly unusual layout may take some adjusting to.

Custom launchers can improve navigation and readability



## ▶ HOW TO SUBSCRIBE...

### ...on an iPad or iPhone

- STEP 1** Return to the *Computer Shopper* library
- STEP 2** Choose your subscription term and tap twice on the 'price' box
- STEP 3** Choose whether to create an optional PixelMags account
- STEP 4** Enter your Apple ID password to confirm



### ...on a Kindle Fire

Kindle Fire subscriptions come with a **FREE** one month trial.

- STEP 1** Tap 'Free Trial Subscription' in the *Computer Shopper* library
- STEP 2** Choose your subscription term from the drop down menu on the popup that appears
- STEP 3** Tap 'Subscribe'



### ...on an Android device

- STEP 1** Open the Google Play Store homepage and navigate to the Newsstand section using the tabs at the top
- STEP 2** Search for *Computer Shopper* using the search icon in the top right of the screen
- STEP 3** Click the 'Subscribe' button and pick your term
- STEP 4** Enter your Google password to confirm



### ...via the Zinio app

- STEP 1** Search for *Computer Shopper* via the search box in the Shop tab
- STEP 2** Tap the 'Subscribe' button
- STEP 3** Choose whether to create an optional Zinio account
- STEP 4** Enter your Apple ID password to confirm



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Each issue of *Computer Shopper* will be delivered directly to your device each month.

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# How to... Discover IP addresses

If you want to solve problems on your network or do anything advanced, you'll need to know how to find IP addresses. Here's how

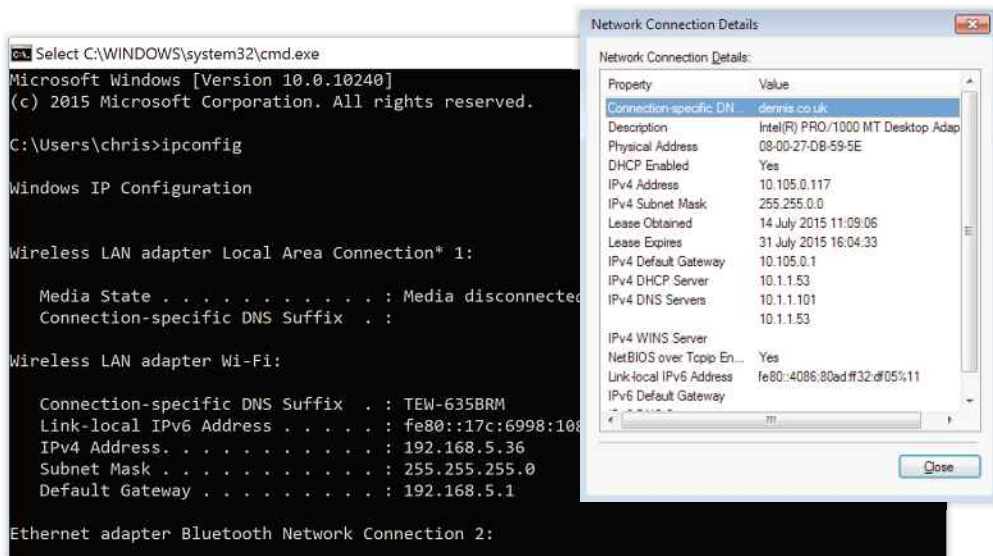
**EVERY COMPUTER ON** a network has a unique IP address, which is the computer equivalent of a postal address. You don't normally have to worry what your IP address is, or even have to use it, but there are times when you'll need to find it out. If you want to share files from

your computer, for example, or set it up to play games over the internet, knowing its IP address is vital. You often also need to find out your router's IP address if you want to access its settings. Here we'll show you how to find out this information from any computer.

## WINDOWS

Press Windows-R, then in the box that pops up, type 'control netconnections' and press Return. This will bring up your network connections box. From this list, click the live network connection icon (it will be blue) and, from the toolbar, click View status of this connection. If you can't see this option, you may have to click the '>>' icon in the toolbar first. Click the details button and a new dialog box will pop up. The IPv4 address listed is your computer's address. Your router's IP address is the IPv4 Default Gateway.

An alternative way to find this information is to press Windows-R, then type 'cmd' and press Return to bring up a command prompt. Now type 'ipconfig' and press Return. This will show the status of all the network connections on your PC.



## ANDROID

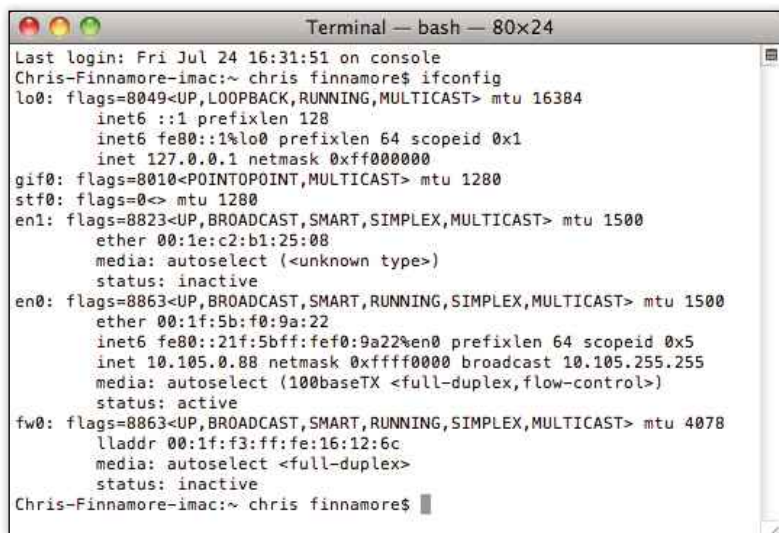
Android, annoyingly, only shows you your device's current IP address, but it won't show you your router's address. To get this information, you need an app, such as Network Info II ([tinyurl.com/332networkinfo](http://tinyurl.com/332networkinfo)). Once you've installed it, connect to your Wi-Fi network, run the software and tap the WiFi tab. You'll see your address under IP and your router's address listed as the Gateway.



## MAC OS X

Open System Preferences from the Apple menu and select Network. Choose your active connection, which will be coloured green. For wired (Ethernet) connections, you'll see your IP address listed under IP Address, and your router's address listed next to Router. For wireless connections click Advanced, then click TCP/IP. You'll see your IP address and router address listed there.

An alternative way is to open the Terminal, then type 'ifconfig' to view the status of all your network connections, and 'route -n get default' to show your gateway.



## IPHONE/IPAD

Go to Settings, Wi-Fi and click the 'i' icon next to the network you're connected to (it's at the top of the list and has a tick next to it). Your IP address and router's IP address are clearly marked.



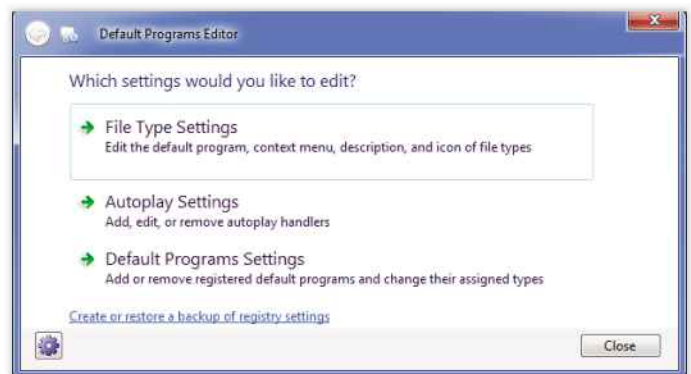
# How to... Set default applications

Windows' built-in default application tool is pretty limited. We show you how to use Default Programs Editor to make Windows load the right program at the right time

**WHEN YOU DOUBLE-CLICK** a file in Windows, whether it's a text document, an audio file, an image or anything else, it will normally open in an associated application. You can change this in the Control Panel under Default Programs, but this is all you can do; you can't

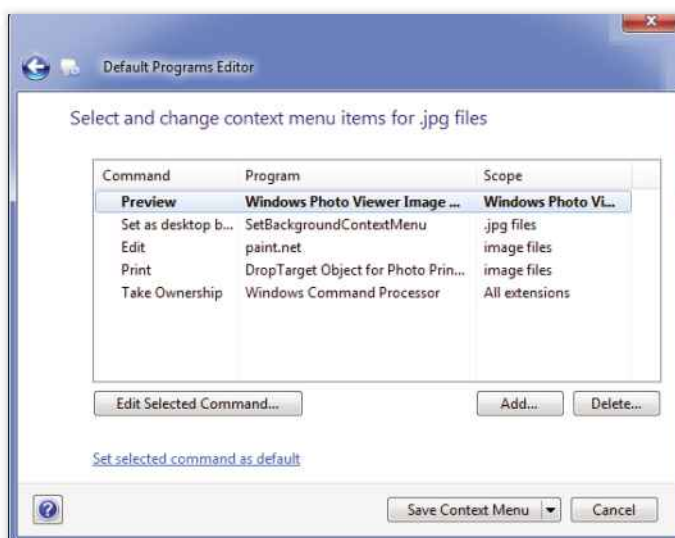
change what happens when you right-click, for example. To really take control of your files, you need the Default Programs Editor. This free utility lets you change default programs, edit right-click context menus, and much more besides. Here's how to use it.

**01** Go to [defaultprogramseditor.com](http://defaultprogramseditor.com) and click the Download Now button. Extract the Zip file to a convenient location; it will run from anywhere. Double-click the program to run it. Windows may prompt you to download and install the .NET Framework, so click the button to do so. Once the program has run, you can install it to the Windows Control Panel. Click the cog icon at the bottom of the page, then click Install to the Control Panel. You'll now be able to go into the Control Panel and click Programs to find the Default Programs Editor.



**02** To edit a context menu, click File Type Settings, then Context Menu. Now scroll down to find the file extension you want, or use the search box. For example, if you want to change the context menu for photos from your camera, select or search for 'jpg'. Click Next. The next screen will show you the options for the file type, with the name of the menu entry and associated files and programs. Select the entry you want to alter, such as Edit, and click Edit Selected Command.

**03** In the next screen, click Browse to find the program you want to use to edit your images. For example, if you want to use Paint.NET, click Browse and navigate to C:\Program Files\paint.net, then double-click PaintDotNet.exe. Click Next to go back to the Context Menu. Here you can change other context menu items, or just click Save Context Menu to finish editing. Now when you right-click a JPG image and select Edit, it will open in Paint.NET instead of Windows Paint, which is much more useful.



**04** The process for editing icons, descriptions and default programs is self-explanatory; just select the relevant option and the file type you want to change, and follow the steps. Autoplay settings are more involved. Click Autoplay Settings, select the media type you want to change, such as a DVD movie, and click Next. The next screen shows you the choices Windows gives you when you put a DVD in your PC; you won't be able to edit the built-in Windows commands, such as 'Ask me every time'. Click the action you want to modify, such as 'Play DVD movie' and click Edit Selected Handler. Now click Browse to find the program you want to use to play DVDs, such as C:\Program Files\VideoLAN\VLC\vlc.exe. You can tick the two 'Infer' boxes to make Default Programs Editor work out the program name and assign an appropriate icon. Click Next followed by Save Autoplay Settings. **CS**

# How to... Use Twitter



Twitter is a powerful tool for sharing information, customer support and current affairs. **Barry Collins** shows you how to get started with it

**ALMOST A DECADE** after it launched, Twitter remains the hottest social network on the internet. It's a service for chatting with friends, interacting with the rich and famous, getting a response from businesses, sharing interesting links and, of course, photos of cats. Yet it's frequently abused – not just by morons posting death threats to celebrities, but by ordinary users who don't quite grasp its intricacies.

## 01 CHOOSE A MEMORABLE USERNAME

The first task on Twitter is arguably the most important: choosing your Twitter handle. Ten years after launch, you're not about to walk up and claim @BobSmith (the @ sign appears before every Twitter username), so think of something original or ways to adapt your name: @BrightonBobby, for example, or @BobTheAccountant. Twitter isn't case-sensitive, by the way: @BrightonBobby and @brightonbobby are one and the same.

If your chosen username has already been reserved, Twitter will suggest alternatives, normally involving numbers (@BongoBobby3) or extra punctuation (@Bongo\_Bobby). Avoid the latter, as unusual characters such as underscores are difficult to type in on mobile phone keyboards. You can change your Twitter username later if you make a bad choice by going to Settings and selecting the Account tab. You will still keep any followers you acquired under your original name.



## 02 LURK AND LEARN

After you've chosen your username, Twitter will ask you to pick a range of interests and suggest accounts of people you might follow on the network. Pick a dozen or so to get going with and spend the first day or so just watching and learning – seeing how people use the service, how they interact, and picking up the customs. You won't have any followers at this stage anyway, so there's little point in posting, as nobody will read it.

During the setup process, Twitter will also suggest friends who use Twitter based on contacts from the email address you signed up with. Following and interacting with friends is a good way to get started, as they're going to be more responsive and forgiving of newbies than @Lord\_Sugar, who has four million followers to tolerate.



In this guide, we're going to provide practical advice on how to get the most from Twitter, with tips for those who have yet to open an account through to those with tens of thousands of tweets to their name. We'll deliver guidance on the difference between Twitter's public and private channels, how to properly deal with nuisance and spam accounts, advice on the best Twitter clients, and much more.

## 03 PROTECT TWEETS FROM PRYING EYES

Anything you publish on Twitter is, by default, thrust into the public domain. Anyone can read it, even if they don't follow you, either by using Google, the Twitter search engine or by visiting your Twitter page. If you don't want others to read your tweets, go to Settings, Security and Privacy and tick Protect My Tweets.

Now only people you approve as followers will be able to read your tweets. This places limitations on how you use the social network: others won't be able to retweet you, and only your approved followers will see your replies to their tweets. So unless @PiersMorgan follows you, you won't be able to tweet him your opinion of his latest column.



## 04 WHAT'S PRIVATE AND WHAT'S REALLY PRIVATE?

A classic Twitter mistake is to believe that tweets or replies directed to one person can only be read by that person. In fact, anyone who follows you both will see that message appear on their timeline, and that tweet will also appear in search and on your Twitter page.

If you want to communicate privately, use the direct messaging (DM) system, accessed by clicking Messages. Twitter recently added the facility for group DMs, letting you chat with more than one person. By default, you can only send DMs to people who follow you, but you can allow anyone to send you DMs by ticking the box in Settings, Security and Privacy.



## 05 DON'T SHUT OUT FOLLOWERS

While starting a tweet with someone's username doesn't make it private, it does mean only those people who follow both you and the recipient will see it. You'll often see tweets such as "@GaryLineker was wrong about that offside", which only followers of the sender and Gary will see. If you want all your followers to see it, put a full stop at the start of the message ("@GaryLineker was wrong about that offside").







## 06 GET A TWITTER CLIENT

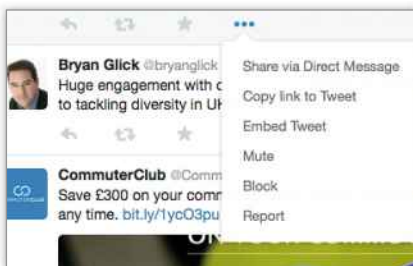
The Twitter website is pretty poor for power users: your timeline doesn't update automatically, and replies and direct messages are hidden away. To keep an eye on Twitter while you work, download a Twitter client for your PC. Our favourite is the TweetDeck app for Google Chrome, which can be pinned to the Windows taskbar so it in effect runs as a standalone app, even if you don't have Chrome open.

TweetDeck provides separate columns for your timeline, notifications, messages and favourites, all of which update in real time. You can also use TweetDeck to manage more than one Twitter account. We prefer the dark theme and to reduce the default font size to its smallest setting, both of which you'll find if you click on the Settings cog in the bottom left corner of the TweetDeck window. If you don't use Chrome, you can run TweetDeck as a web app from [tweetdeck.twitter.com](http://tweetdeck.twitter.com). Press F11 to make the TweetDeck window run full screen.

## 07 MUTE, BLOCK OR REPORT?

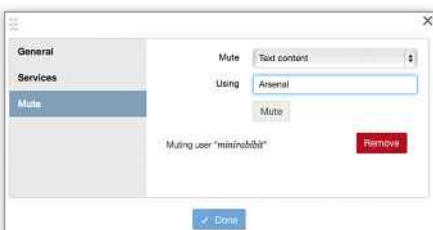
Twitter is plagued by idiots, spammers and trolls. Unless you're a celebrity, you're unlikely to be bothered much, but knowing how to deal with troublemakers is crucial. Twitter provides three options: mute, block or report.

Mute hides someone's tweets from your timeline, allowing them to continue sending you messages that you won't see unless you take them off mute. It's a good way of politely ignoring a nuisance follower. Blocking prevents the person from following you, and none of their messages will appear on your timeline. It won't prevent them reading your tweets, but it stops them from interacting with you. Report is how to deal with spam, or offensive or threatening messages, which Twitter may investigate. Twitter doesn't have a great track record in dealing with abuse, but it's promised to step up its game. All these options can be found by clicking the three dots beneath each tweet on the Twitter website, or in the various clients and Twitter apps.



## 08 FILTER TWEETS ON PARTICULAR TOPICS

Want to follow someone, but tired of them banging on about a particular topic? Twitter clients such as TweetDeck and other apps allow you to mute tweets based on certain keywords. In TweetDeck, you can set this up by clicking the Settings cog, choosing Mute from the left-hand panel and choosing Text content. Add the phrase you wish to ban (such as 'Arsenal') in the Using field and click Mute. Now all tweets about the team will be banished from your TweetDeck timeline – as long as they use that word and not 'Gunners' instead.



## Twitter glossary

**@REPLY** When you message or reply to someone directly over Twitter. The message is still public, and will appear on the timeline of anyone who follows both participants of the conversation.

### DM (DIRECT MESSAGE)

Twitter's private messaging channel, where only the recipient(s) will be able to see your messages, unlike public tweets.

### FAVOURITE

Clicking the star icon beneath a tweet will Favourite the tweet. It's a way of showing you like a particular tweet and also a means of bookmarking a tweet for later reference, if it contains a link to an article, for instance. Go to [twitter.com/favorites](http://twitter.com/favorites) to view yours.

**HASHTAG** A means of tagging tweets about a particular topic, often used by TV shows or

events, such as #QuestionTime. Click on a hashtag to see all the tweets about that topic.

### HT (HAT TIP)

Used when crediting another user for something mentioned in a tweet (for example, "Here's that link to the review. HT @ExpertReviews").

### MT (MODIFIED TWEET)

When someone has edited another person's tweet (normally to keep within the 140-character limit) and republished it on their own timeline.

### NSFW (NOT SAFE FOR WORK)

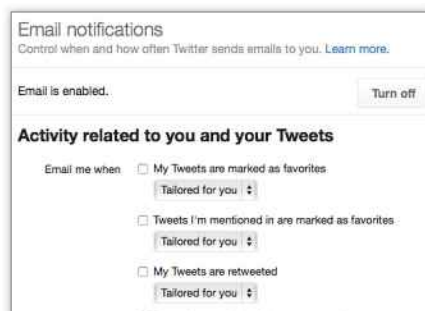
Signifies the tweet contains a link you probably don't want to open in front of easily offended colleagues.

### RT (RETWEET)

The process of rebroadcasting someone else's message on your own timeline. Look for the two arrows symbol beneath a tweet to retweet it.

## 09 STOP TWITTER BOMBARDING YOUR INBOX

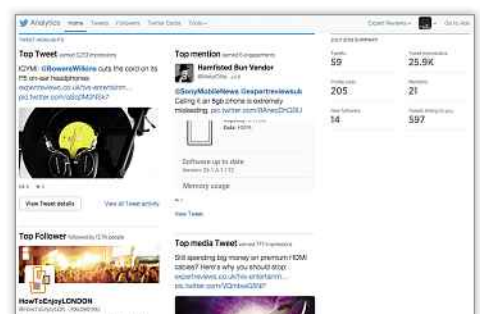
By default, Twitter will ping your email account with alerts for absolutely anything: anytime someone mentions you in a tweet, someone retweets one of your messages, every time the cat breaks wind. If you don't want your email account to collapse under the



weight of Twitter alerts, go to Settings, Email notifications and start unticking boxes. Unless you're thunderously popular, we find alerts every time you get a new follower and every time you receive a direct message to be useful. Anything else is chaff.

## 10 VIEW YOUR TWITTER ANALYTICS

Any Twitter user can access their Twitter analytics at [analytics.twitter.com](http://analytics.twitter.com). The site gives you an absorbing insight into what your most engaging tweets are, or which earned the most retweets. Click the Followers tab and you'll find out what percentage of your followers are male/female, their interests, and where they come from. It's a battery of data, and you can export it all into Excel and crunch the numbers even further. **CS**



# Business Help

If you have databases, office applications and macro issues, **Kay Ewbank** can help. Send your problems to [businesshelp@computershopper.co.uk](mailto:businesshelp@computershopper.co.uk)



## Outlook contacts in strange groups

**Q** I have a simple, but irritating, problem with Outlook 2010's contacts. The Contacts list begins with 'Company (none): 320 items'. Most of my contacts are then listed in alphabetical order. However, at the bottom is another list that begins 'Company (none): 155 items', which also includes all my contact groups and more recent contacts. They should all be in one list, as I only have one account set up. I've no idea why some go into the second list, and I can't move them back to the main list.

If I try to drag a contact from one section to the other, nothing happens. If I right-click 'Company (none): 320 items', it allows me to collapse and expand 'groups'. It seems I have two Outlook 2010 'groups'. I thought I might be able to 'move' them by right-clicking, but it didn't give the other group as an option to move a contact to. What's going on?

Tony Cannon

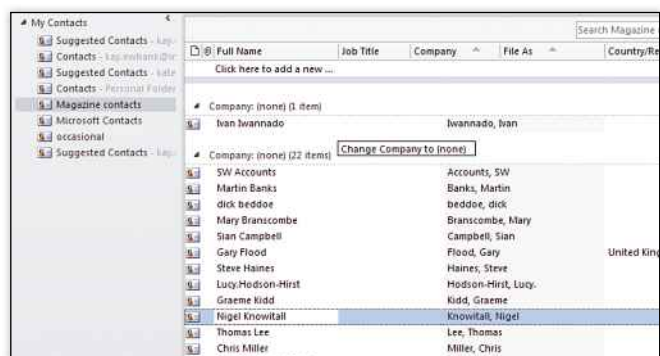
**A** This is a known problem with Outlook, which expects all contacts to have a company name. When you view your contacts in List view, you see them organised in company order. As contacts in a Company (None) group don't have a company name, they're shown separately.

When you enter a new contact in Outlook and don't give a company name, that contact shows in the list of contacts with no company name. However, if you import a list, perhaps

from an earlier email package or the Windows address book, contacts without a company name end up with a different type of empty company name, so Outlook shows the two lists separately. Essentially, one of your two lists has a real empty company name, the other is set to have Null in the company name. The two look the same, but to Outlook, they're different. Once Outlook creates two 'Company (none)' groups, you can't just move items from one group to the other.

There's a simple but long-winded solution: go into each record, add a fake company name, save the contact, then delete the company name and re-save it. This sets all the company names to the same 'nothing', and will eventually get all your contacts into the same No Company group, but it's tedious.

There is a way to cut down on the work. First, open a contact record from the first group. Create a company name such as 'Fakery', and save the contact. Make sure the contact has moved to a new group by itself for that company. Now go back to the contact and delete the company name. Your contact should have moved back to one of your two 'Company (none)' groups. Until you try it, you won't know which group is the 'target' group, but once one contact has moved, you'll know which group you're moving all the others to.



▶ You can move contacts from one group to another in Outlook

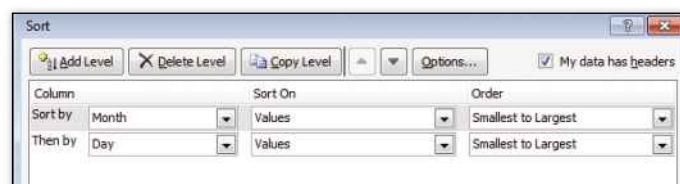
The next stage is to work with the records in the 'source' group for moving. You can work out which group this is by looking at which group your changed record moved to, then choosing the other group.

Open the first contact in this group, and change the company name to 'Fakery' (or whatever you like, so long as it's not a real company name). Save the contact, and make sure it appears on its own in its own group in List view. Now select the rest of the records from the 'source' group, and drag them into the 'Fakery' company group. The source group will disappear as it is now empty. Finally, select all the records from the 'Fakery' group, and drag them into the 'target' Company (none) group. You should now have all your contacts without company names in a single group.

## Advanced date sort in Excel

**Q** I've got a list of dates of birth as part of a list in Excel, and I'd like to be able to sort the list into order by their birthday – in other words, ignoring the birth year and sorting by month and day. Is there a way to use a formula to sort within the column?

Hannah McCoy



▶ Use multiple sort levels to sort on partial dates in Excel

**A** No, Excel doesn't let you use a formula to sort. What you'll need to do is to have two extra columns. Get the month from the date in the first column using, '=Month(A2)' (or wherever your dates are), and the day in the second column using, '=Day(A2)'.

You can then sort the birthdays by selecting the range that includes the birth dates, any other information such as people's names, and the two extra columns. Sort the whole lot ascending on Month, then ascending on Day. To do this, click on the Sort & Filter icon at the right-hand end of the Home tab of the Excel ribbon. Choose Custom sort, and set the sort to be on the Month column ascending. Click on Add level to get a second sorting line, then sort on the Day column ascending, smallest to largest.

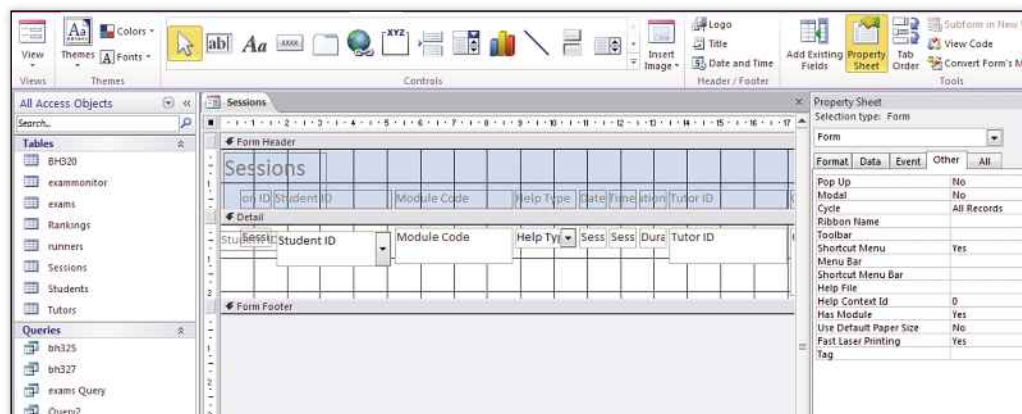
If you don't want to see the two 'helper' columns, you can always hide them by right-clicking the column then choosing Hide.



# Monitor changes in Access

**Q** I have a number of fields in an Access form that could be updated. I want to know if any of the fields in a particular subset have been changed. If the fields have been changed I want to run some code so the changes are correctly handled, and so the right people are notified that the changes have taken place. I know I can check whether there's been a change on the overall form, but I need to know if some of the 'core' fields/controls have been changed. I was going to add some code to each field I'm interested in, but thought it would be neater and easier to maintain if I could add the code to the overall form. Is there a way to do this?

Foy Sy



↑ You can use the Tag property to identify particular controls on a form in Access

**A** There are a couple of ways to achieve this. You could set up a procedure containing the code to be run when one of the controls changes, then have a call to that procedure from the AfterUpdate event of each of the controls/fields you want to keep an eye on. That would get over your worry about having only one copy of the code, and it would probably be the method I'd choose.

Another option is to attach the code you want to run to the BeforeUpdate event of the form. As you know, this will be triggered when the user moves to a new record, but before any changes are saved. What you need is a way to further identify if one of your specific controls has been changed. You could do this using an If statement (or a Case statement) that contains a list of all the controls you're interested in, along the lines of:

```
If Me.Tutor_ID.OldValue <> Me.Tutor_ID.Value Then
    MsgBox("Your code, or a call to your procedure, goes here")
End If
```

This makes use of the fact that the OldValue property of the control keeps the old value until the record is updated. You'd include this for each of the controls you want to check.

Another technique would be to use the Tag property of the controls you want to keep check on. The Tag property can assign an identification string to an object without affecting any of its other property settings or causing other side effects. If you want to use this method, set the Tag property of each control to something to identify them – CS for Computer Shopper, or Core for core control.

You could then use code like this in the BeforeUpdate event of the form:

```
Private Sub Form_BeforeUpdate(Cancel As Integer)
    Dim ctrl As Control
    Dim chngs As Integer
    chngs = 0
    For Each ctrl In Me.Controls
        If ctrl.Tag = "Core" And (ctrl.OldValue <> (ctrl.Value) Then
            chngs = chngs + 1
        End If
    Next ctrl
    If chngs > 0 Then
        'your code to be run when changes have occurred goes here'
    End If
End Sub
```

# Incorrect index entries in Word

**Q** I've set up an index in a Word document, and realised that some entries are incorrect. I created the Index Mark by selecting the word, then clicking Mark Entry on the References page of the Office Ribbon. How can I delete incorrect marks?

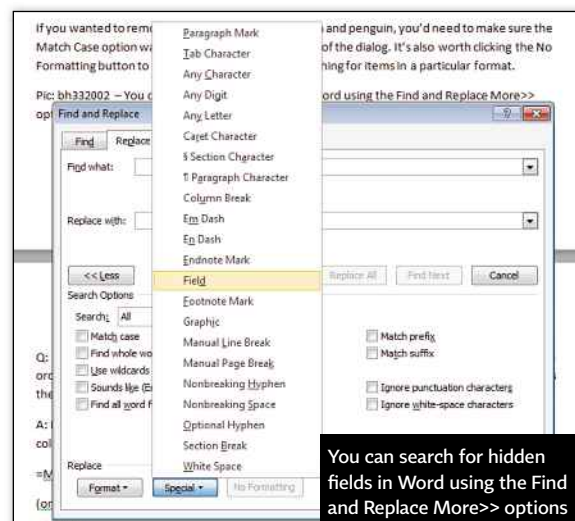
Ed Rudd

**A** Index marks are actually hidden fields and you need to tell Word XE 'Word' to show hidden text. If you click on the ¶ button on the Home tab, this will show all the non-printing marks, including hidden text. If you choose this option, your index marks will appear as {XE "Index entry"}, where Index entry would be whatever you'd chosen as the entry when marking the index entry using References, Mark Entry.

Once you can see the index marks, you can move through your document, find the incorrect marks and delete them. If you need to delete multiple marks and want a faster way to work on several at once, you can use

the Find and Replace dialog. To remove all index marks, do a find and replace, setting the Find entry to '^d XE' and setting the Replace entry to nothing – '^d' is the special character to search for a field. As an alternative to typing it manually, you can use it by clicking the More>> button in the Find and Replace dialog, then clicking on the Special button, before finally choosing Field. That will get you the '^d', and you can then add XE.

If there are specific index entry fields you want to replace, you can do so by entering the value you want to remove as well as the field type, so to remove all the index entries for Penguin from your document, you'd use a Find expression of '^d XE "Penguin"'. If you want to remove the entries for 'Penguin' and 'penguin', make sure the Match Case option isn't ticked



in the More>> view of the dialog. It's also worth clicking the No Formatting button to make sure you're not just searching for items in a particular format. ☐

# Helpfile

Whatever your general PC, hardware and software woes, **Simon Handby** is here to help. Send your problems to [help@computershopper.co.uk](mailto:help@computershopper.co.uk)



## Replacement laptop battery won't charge

**Q** After a couple of years' daily use, the battery on my Toshiba Satellite C670/C670D laptop now lasts less than an hour between charges. You can't get original Toshiba batteries for this unit now, so I ordered a compatible replacement from an online supplier. I couldn't get it to work and, after much correspondence, the supplier said it was a compatibility issue and refunded my money. Undeterred I ordered one from a different supplier, but with the same result.

There are two LEDs on the front of the laptop. When the charger is plugged in, the left-hand one should glow red. Once it's fully charged, the right-hand LED should glow green. When I put either replacement battery in, the red charging LED just flashes slowly. Even after the charger has been plugged in for hours, the laptop won't start up. Everything works fine with the original battery in place.

I started the laptop with no battery in and the charger connected. With either replacement battery inserted I'm told that no battery is detected. Can you suggest a fix?

Dave Lee, [nhsdave@btconnect.com](mailto:nhsdave@btconnect.com)

**A** In theory laptop batteries and charging systems should be able to talk to each other using the Smart Battery System. In practice we've seen problems where an original battery wouldn't



charge in a laptop when using a third-party replacement power adaptor, and it wouldn't surprise us to see similar issues when using a third-party battery. If the computer can't recognise the charge state and condition of an installed battery, the safest option is not to use it, and certainly not to charge it.

The user manual for your Toshiba says a blinking orange indicator shows the battery has very little charge, rather than a fault. Obviously there is a problem, though, as this indicator should be on solidly if the battery is charging, and turn green when it's charged.

A BIOS update should solve the problem. Check which BIOS revision you have by

opening the Start menu, clicking All Programs, opening the Toshiba folder, then running HW Setup from Utilities. If you've uninstalled that software, you should be able to find the current version by rebooting and looking on the 'Toshiba - leading innovation' screen, or by pressing F2 on that screen to enter the BIOS setup. Once you've made a note of which revision you have installed, visit [tinyurl.com/332toshbios](http://tinyurl.com/332toshbios), find your exact model and check if there's a more recent BIOS available. If so, download and install it with the help of the instructions at [tinyurl.com/332toshupdate](http://tinyurl.com/332toshupdate).

If updating the BIOS doesn't fix the issue, try power-cycling the laptop: remove the battery, unplug the computer from the mains so that it's completely unpowered, and hold down the power button for 30 seconds to ensure that any residual power is gone. Then re-fit the battery, connect to the AC adaptor and see if the problem is cured.

If neither suggestion helps, we'd strongly suspect the battery simply isn't compatible. A quick search suggests that it may still be possible to get an original, Toshiba-branded battery for this model: try searching for the battery type and including the term 'OEM' (original equipment manufacturer). Be cautious, however, and be sure to avoid 'OEM compatible', 'OEM equivalent' or similar phrases which translate as 'not OEM'.

## Optical drives aren't working

**Q** I have a Dell Inspiron 1520 on which I've upgraded the hard disk and RAM, and updated the operating system from Windows Vista to Windows 7. Unfortunately, its DVD writer recently stopped working: in Device Manager it displays a code 39 error stating that it cannot load the driver.

I've tried right-clicking and uninstalling the device from Device Manager, but when it's re-detected after a reboot, the same problem occurs. I downloaded new firmware from the Dell website, but the installer can't find the drive in order to install it.

I assumed that the drive itself had failed, so I bought a new Lite-On external device

that connects via USB. Unfortunately, this has exactly the same problem. Can you suggest a fix?

Kenneth Oldfield, [oldfield806@btinternet.com](mailto:oldfield806@btinternet.com)

**A** Windows can sometimes experience problems with the optical drive if you've upgraded to a new version, or if you've added or removed burning software. Fortunately there's a Microsoft Fix it troubleshooter designed to quickly cure the problem. Download and run the correct one for Windows 7 from [tinyurl.com/332fixit](http://tinyurl.com/332fixit). Answer the questions and allow it to finish, and you should find that both drives work correctly.







# Make OpenWRT more awesome

PART  
2

Last month we showed you how to install the OpenWRT router firmware. This month **Clive Webster** shows you how to turn your router up to 11



**LAST MONTH WE** showed you how to replace your router's limited software with the reliable OpenWRT custom firmware. The process may not be the most straightforward (this is *Advanced Projects*, after all), but we feel it's worth the effort; even the basic OpenWRT system has clear advantages over the fanciest standard router firmware. This month we're going to show you how to add extra capabilities to your OpenWRT router through the medium of apps.

There's a slight chance of something going wrong when installing an app, so now is a good time to back up your OpenWRT router and all the settings you applied from last month's guide. Log into your router and go to System and then Backup/Flash Firmware. Now click Generate archive. A tarball archive (.tar.gz) file will be created in the default downloads folder of your PC. To revert your router to this particular state all you need to do is log in to the interface, head back to System, Backup/Flash Firmware and select this .tar.gz file with the Restore backup tool. If your router ever looks as if it's stalled, you

should still be able to navigate to System, Reboot, which usually fixes things – this is preferable to just turning the router off. If your router ever becomes unbootable, carefully follow the steps at [wiki.openwrt.org/doc/howto/generic.failsafe](http://wiki.openwrt.org/doc/howto/generic.failsafe) to recover it.

## QUALITY OF SERVICE

OpenWRT doesn't come with a Quality of Service (QoS) package as standard because of its 'OS and apps' construction; you have a choice of QoS packages, and which you install depends on how you'll use your router. We'll assume you're not making a VoIP appliance (for which you might want `opensips-mod-qos` QoS) so install `luci-app-qos` (see box, below). You should never have more than one QoS package installed at once.

Once the package has installed, you'll find a new section in the Network menu called QoS. The top section is for WAN (internet) connections, so only enable this if the router you're configuring is your main Gateway router. If you do enable WAN-based QoS, also enable the Calculate overhead option, which

will reduce traffic latency. Your ISP should tell you if your connection is half-duplex or not (hopefully not), and you can find your connection speeds by running a test at [speedtest.net](http://speedtest.net) (multiply the results by 1,000 to convert from Mbit/s to the required Kbit/s). Experiment with these settings to see if you can squeeze a bit more speed from your connection or whether throttling it slightly gives you a more reliable service.

QoS prioritises a type or source of data, ensuring that time-sensitive data streams such as films aren't interrupted by non-time-sensitive streams such as downloads. To add a new QoS rule, click the Add button at the bottom of the Classification Rules section. Change the Target to Express for higher-priority traffic and to Low for the lowest priority, and enter the IP address of the device for which you want to prioritise traffic as either the Destination host or Source host (you can make these QoS IP addresses static via your main Gateway router's interface).

We can't think of many situations where you'd need to prioritise traffic from a network

## Adding apps

Installing apps and features on OpenWRT is easy. Go to System, and then Software **01** and you're in the LuCI equivalent of an app store, although everything in this store is free. Every time you reboot the router, you'll have to click Update lists before installing anything **02**. If you know the exact name of the package you wish to install, type it into the Download and install package box **03** and click OK; if not, type a general term into the Filter box **04** and click Find package. Installed apps and services show up in the Installed packages list **05**, but if you've used the Filter tool you'll have to switch to the Available packages tab **06** to see a list of packages that meet your search criteria. Click the Install hyperlink to install the package, agreeing to the dialog box that appears when you do so. Be patient while apps install; when the readout above the storage bar stops updating your new software should be ready to use.

OpenWrt | OpenWrt Attitude Adjustment 12.09 | Load: 0.08 0.03 0.05 | Changes: 0

System Administration **Software** Startup Scheduled Tasks LED Configuration Backup / Flash Firmware

**Software**

Actions Configuration **02**

No package lists available ☒ Update lists

Free space: 93% (4.70 MB)

Download and install package:  **03**

Filter:  **04**

**Status**

**05** **06**

Installed packages Available packages

	Package name	Version
<a href="#">Remove</a>	base-files	117-r36088
<a href="#">Remove</a>	busybox	1.19.4-6
<a href="#">Remove</a>	dnsmasq	2.62-2
<a href="#">Remove</a>	dropbear	2011.54-2
<a href="#">Remove</a>	firewall	2-55.1
<a href="#">Remove</a>	hotplug2	1.0-beta-4
<a href="#">Remove</a>	iptables	1.4.10-4
<a href="#">Remove</a>	iw	3.6-1
<a href="#">Remove</a>	jshn	2013-01-29-0bc317aa4d9af44806c28ca286d79a8b5a92b2b8



## Required packages

These packages are all required to create a shared network folder from which you can stream media. Those marked with an asterisk should already be installed; if they aren't, then your router may not support networked USB storage.

The optional package `kmod-usb-storage-extras` adds support for some non-standard storage devices such as card readers.

PACKAGE	FUNCTION
<code>kmod-usb-core*</code>	Adds USB support
<code>kmod-usb-ohci</code> OR <code>-uhci*</code>	Adds support for your router's USB controller chip (which uses either the UHCI or OHCI standard)
<code>kmod-usb2*</code>	Adds support for the USB2 standard
<code>kmod-ledtrig-usbdev*</code>	Allows the router's LED lights to represent USB activity
<code>usbutils</code>	Adds USB-based Linux commands such as 'lsusb'
<code>kmod-usb-storage</code>	Adds support for USB storage devices (via the USB Mass Storage standard)
<code>kmod-fs-ext4</code>	Adds support for Linux's ext4 file system
<code>e2fsprogs</code>	Adds essential ext2/3/4 (Linux) file system utilities for formatting and error-checking
<code>block-mount</code>	Adds automatic USB drive mounting and checking
<code>luci-app-samba</code>	Installs the latest version of OpenWRT's Samba file server
<code>luci-app-minidlna</code>	Installs a DLNA media server

Source; possibly you could set a NAS as a low-priority Source so big file transfers don't clog up your network, but this is a niche use. You're more likely to need to set QoS for a network Destination, as we explain below.

The highest priority setting must only be used for small-packet data such as DNS name resolutions; using this setting for high-bandwidth traffic will render your network unusably slow. In our example (see the screenshot, below) we made our smart Blu-ray player (on 192.168.1.63) an Express Destination host in order to prioritise video and audio streaming to it; we made our NAS (on 192.168.1.51) a low-priority Destination host to prevent downloads and file transfers to it from clogging up the network. Remember to click Save & Apply at the bottom of the screen to apply your changes.

You can create some very fancy rules with the QoS package: a rule to prioritise TCP ports 80, 442 and 443 will prioritise traffic from Netflix and Amazon Instant Video, thus ensuring the best possible video-streaming

## FIREWALL PORTS TO OPEN

Name	Protocol	Port number
NetBIOS Name Service	UDP	137
NetBIOS Datagram Service	UDP	138
NetBIOS Session Service	TCP	139
Microsoft Directory Services	TCP	445

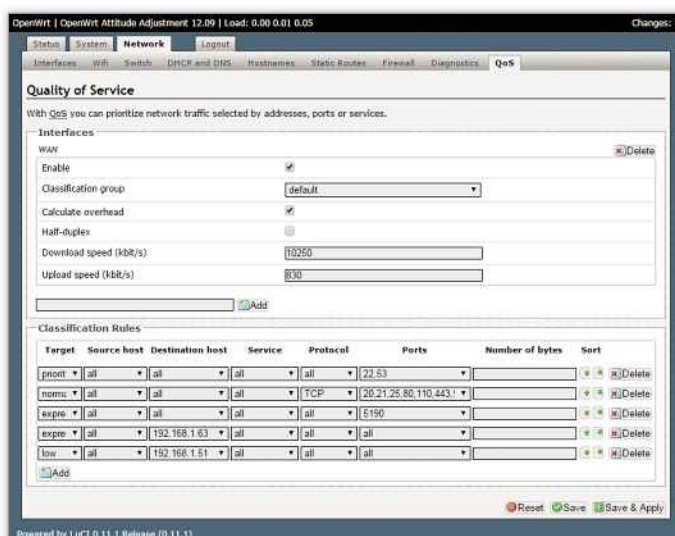
service while not allowing the other services of our Blu-ray player such privileges.

## USING A USB DRIVE

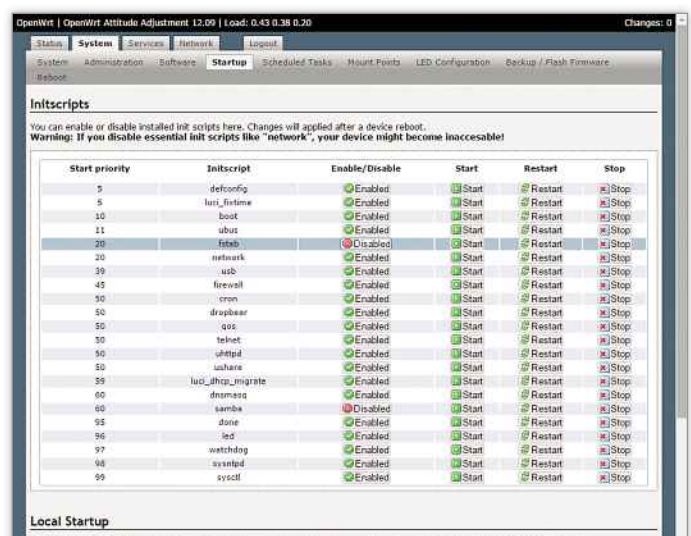
Configuring your router to act as a NAS – sharing a storage device across your network and streaming media – not only requires a fairly long list of additional packages (see 'Required packages', above) but a strict setup sequence. Once you've installed all the packages, check that they're all running by visiting Software and then Startup. Click any Disabled icons to toggle the packages to Enabled mode.

Once everything's installed and running, plug in your USB storage device. A router's USB port may not provide much power, so USB flash drives of 32GB capacity or more, and 2½in portable hard disks, may not work.

To simplify the sharing process, format the USB storage device with the ext4 (Linux) file system. You have to do this remotely via SSH; Linux and OS X systems have SSH clients built in, while Windows users should download PuTTY (see [tinyurl.com/puttydownload](http://tinyurl.com/puttydownload)). Enter the IP address of the router into whichever SSH client you're using, then enter your login details. Now type the command `mkfs.ext4 /`



↑ Use QoS to prioritise media streaming to your Blu-ray player and de-prioritise traffic to your NAS



↑ After we'd installed all our USB sharing and streaming packages, we had to enable fstab (file system table) and samba

Firewall - Traffic Rules		
Traffic rules define policies for packets traveling between different zones, for example to reject traffic between or from the router.		
Name	Match	Action
Allow-DHCPv6-Renew	IPv6-UDP From any host in wan To any router IP at port 547 on this device	Accept input
Allow-Ping	IPv4-ICMP with type echo-request From any host in wan To any router IP on this device	Accept input
Allow-DHCPv6	IPv6-UDP From IP range FE80::0:0:0:0:0:0:0:10 in wan with source port 547 To IP range FE80::0:0:0:0:0:0:0:10 at port 546 on this device	Accept input
Allow-ICMPv6-Input	IPv6-ICMP with types echo-request, echo-reply, destination-unreachable, packet-too-big, time-exceeded, bad-header, unknown-header-type, router-solicitation, neighbour-solicitation, router-advertisement, neighbour-advertisement From any host in wan To any router IP on this device	Accept input and limit to 1000 pkts. per second
Allow-ICMPv6-Forward	IPv6-ICMP with types echo-request, echo-reply, destination-unreachable, packet-too-big, time-exceeded, bad-header, unknown-header-type From any host in wan To any host in any zone	Accept input and limit to 1000 pkts. per second
NetBIOS Name Service	Any UDP From any host in wan To any router IP at port 137 on this device	Accept input
NetBIOS Datagram	Any UDP From any host in wan	Accept input

**Firewall - Traffic Rules - NetBIOS Name Service**

This page allows you to change advanced properties of the traffic rule entry, such as matched source and destination hosts.

Rule is enabled ☐ Disable

Name: NetBIOS Name Service

Restrict to address family: IPv4 and IPv6

Protocol: UDP

Match ICMP type: any

Source zone: ☐ Any zone ☒ lan: lan: ☐ wan: wan: ☐ Device (input)

Source MAC address: any

Destination address: any

Destination port: any

Destination zone: ☒ Device (input) ☐ Any zone (forward) ☐ lan: lan: ☐ wan: wan: ☐ Device (input)

Open four ports of OpenWRT's firewall to allow reliable file sharing and streaming

Browse your network from any computer and you'll be able to use the share folder of the OpenWRT server as freely as any other

dev/sda -o ^has\_journal, -o extent. If the drive can't be found, try 'sdb' instead of 'sda'. The mkfs tool may worry that you're formatting an entire drive (not just a partition); confirm this is fine (after ensuring the drive has nothing on it you need).

Minimise your SSH client and switch back to LuCI to open four ports of OpenWRT's firewall – go to Network, Firewall, then Port Rules. Enter each port's details as listed in the table on page 137, and then press Add.

These ports are open to the WAN (the internet) by default, which is a bad idea from a security point of view, so you have to click Edit for each port and change its Source zone to LAN (your home network). Don't forget to click Save & Apply after changing each port.

Now head to System, Mount Points and you should see an entry in the Mount Points section that's not enabled. Click Edit and change the details as we've listed in 'Mount Entry' (above). Once done, click Save & Apply and go to Services, Network Shares. Enter your network's name in the Workgroup field (Windows networks will probably be called HomeGroup) and change the Share home-directories option to 0 (off). Add a shared

**Mount Entry**

General settings | Advanced Settings

Enable this mount: ☒

Device: /dev/sda

Mount point: /mnt/shares

Filesystem: ext4

Use as root filesystem: ☐

Run filesystem check: ☒

Use the Mount Point tool to create a folder (/mnt/share) that's linked to your storage device; don't forget to click the Enable box

**Samba**

General settings | Edit template

Hostname: OpenWrt

Description: OpenWrt

Workgroup: HomeGroup

Share home-directories: ☐

Shared Directories

Name	Path	Allowed users	Read-only	Allow guests	Create mask	Directory mask
Share	/mnt/shares		<input type="checkbox"/>	<input checked="" type="checkbox"/>	0777	0777

Add your router to your network via the Workgroup field; create a shared folder via Shared Directories

directory as shown in 'Samba Share' (above). We're fairly sure LuCI doesn't actually set up that shared folder properly so you have to finish the job manually. Switch back to your SSH client and type the commands `chmod 777 /mnt/shares` and `chown -R nobody /mnt/shares` to remove practically all restrictions from the shared folder. Browse your network from any computer and you

should be able to use the share folder of the OpenWRT server as freely as any other.

If you find there's a Lost+Found folder in your share folder, hide it by opening the Edit template tab of Network shares and add the line `hide files = /lost+found/` at the end. If you want to stream video or audio from your router to a Blu-ray player or similar device, you'll need to enable miniDLNA, found under the Services section of LuCI. Enable the service, change Media directories from /mnt to /mnt/shares and click Save & Apply.

## Performance testing

We compared the performance of our TP-Link TL-WR2543ND router with TP-Link's own software installed and once we'd installed OpenWRT. With TP-Link's software, at 10m distance we couldn't get a 582MB file to copy to a USB drive plugged into the router at all, but with OpenWRT installed we could browse our flash drive freely. Indeed, with OpenWRT installed we could load films on to the storage plugged into our router at faster rates over Wi-Fi than we could with an Ethernet cable when using TP-Link's software.

## NEXT MONTH

### MAKE A SMART FAN CONTROLLER FOR YOUR PC

Use an Arduino board and few standard electronic components to keep your PC cool and quiet



# Producing sound effects for video productions

Most sound effects in films and TV shows are added after the video has been shot. **Ben Pitt** reveals the techniques to make productions go off with a bang



**SOUND EFFECTS ARE** a crucial component in any action film, TV or computer game production. The most famous examples are as recognisable as the stars or the theme tune, from the searing swoosh of the Tardis to the stuttering electronica that accompanied The Six Million Dollar Man and his bionic powers. The *Star Wars* franchise is packed with iconic sounds from lightsabers to R2D2's bleeps and TIE Fighters to Vader's heavy breathing.

Sound effects aren't limited to science fiction. There's a famous scene in *The Godfather* where Al Pacino's character shoots two men in a restaurant. The mounting tension could have been underpinned by a rousing musical soundtrack but instead it's expressed by the rattle and screech of a passing train. Another off-camera train is used for a very different effect in *Spider-Man* (2002). It's heard in the background in Peter Parker's apartment, and in the director's commentary Sam Raimi describes how it's used to convey a sense that Peter lives in relatively humble surroundings, right next to the train line. These kinds of sounds could easily have been omitted, but including them adds an extra layer of creativity and expression to the filmmaking process.

## FOLEY MOSES

Very few sound effects are recorded on location while filming, with most either taken from sound libraries or created in the studio. The latter is known as Foley, and the work of a Foley artist strikes us as one of the more enjoyable ways to earn a living. Much of their work is pretty straightforward: the sound of footsteps on gravel is created by someone



(Photo credit: 'Foley Room at the Sound Design Campus' by Vancouver Film School, licensed under Creative Commons)

silent version of the musical *Show Boat* needed a soundtrack. Jack Foley was the man charged with the task of adding sound effects in sync with the action. His techniques became standard practice throughout Hollywood and continue to this day.

**Directors have no time on set to record all the sound effects live, as they'd need a massive array of microphones**

walking on some gravel, for instance. However, when a sound is needed for an alien falling into a combine harvester, it's down to the Foley artist's imagination to bring the sound – and the scene – to life.

Foley dates back to the 1920s and the first 'talkies' that marked the end of the silent film era. Warner Studios had just released *The Jazz Singer*, and Universal realised its upcoming

Virtually all sound effects are added in post-production rather than being recorded on set. That's because the best position for a microphone is usually a couple of feet away. Directors usually try to record dialogue on-set, although this too is often overdubbed later on. Directors have no time on set to record all the sound effects live, as they'd need a massive array of microphones that

would end up in the shots. It's much easier to piece together these sounds later on.

In those early days the Foley track was performed live in one continuous take as the Foley artists watched the film being projected. This practice continued right up to the 1970s, when multitrack recording made it possible to piece the various elements together in multiple passes. Today, digital recording makes it easy to place sounds freely on the timeline, but Foley artists still perform their craft live and in sync with the moving images. Doing so makes it easier to get an emotive performance that connects with the scene and the viewer. It's also much quicker than manually placing each and every footstep on the timeline.

There are some fascinating examples of professional Foley artists at work on YouTube. One by YouTube user SoundIdeasCanada ([tinyurl.com/soundideas](http://tinyurl.com/soundideas)) is like watching two virtuoso performers at work. It just happens

that their chosen instruments are sheets of steel, planks of wood and sides of beef.

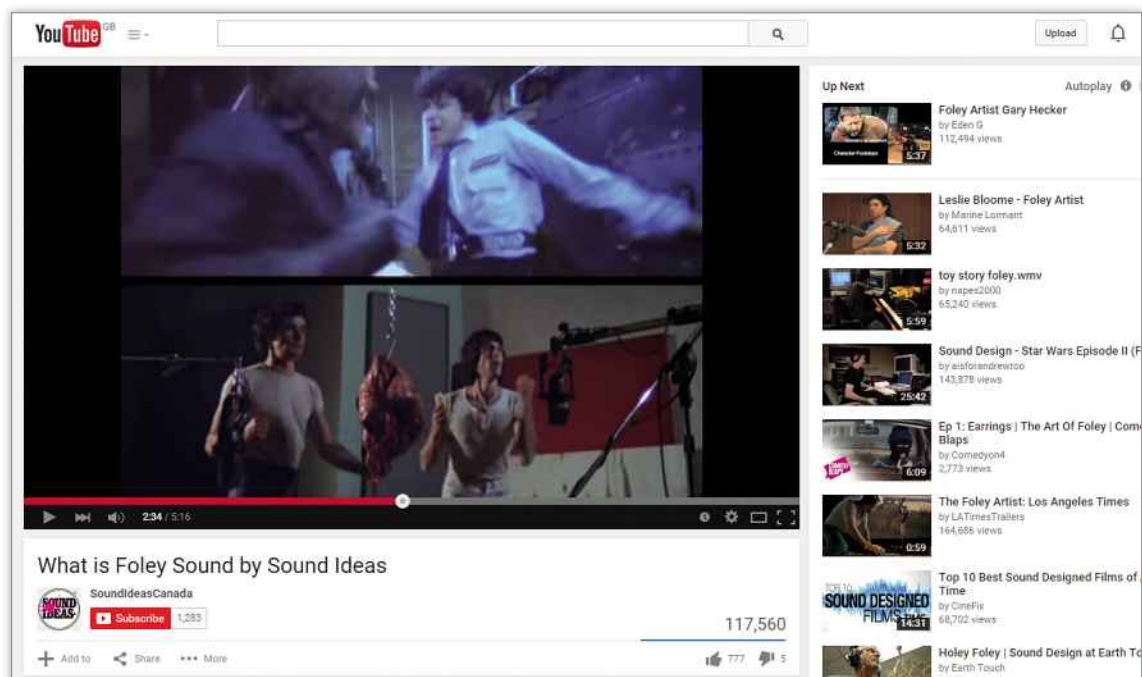
Foley and other sound effects aren't just for big-budget films and TV productions, though. Low-budget and zero-budget productions benefit just as much, and that includes documentaries, promotional business videos and animated logos. The effects are cheap to produce, too. Most of the props used by professional Foley artists are household objects, and part of the fun is trying to make exotic sounds from the props you have available. The recording equipment and online sound effects libraries needn't be expensive, either.

### GET KITTED OUT

You'll need a microphone and recording device to capture Foley, but bear in mind that your video camera has both of these built in. Soundtracks from cameras' microphones are often a bit ropery, but that's more about microphone placement than the quality of the device itself. The microphone should be placed a couple of feet from the source to get a clear, clean recording, but video cameras tend to be positioned much further away.

One possible downside of using the camera's microphone is that not all cameras allow manual volume control, and even fewer have a headphone socket so you can monitor the results. Automatic volume control can be handy to avoid distortion but it can also lead to increased background noise as the camera boosts the volume in quiet sections.

Another option is a dedicated handheld recording device. These have high-quality stereo microphones and record in Wav format to SD cards. Some include XLR inputs to attach external microphones, too. They're made by Tascam, Zoom and Olympus, with prices starting at around £80.



↑ There are some great examples of Foley on YouTube, including this virtuoso performance from the 1970s

Using a computer, an audio interface with XLR inputs and XLR microphones means you can record directly into your video-editing software's timeline. Most editors include a narration function that allows you to play the video back while recording an audio track. This saves having to synchronise the recording later. The downside is that desktop PCs aren't very portable. Laptops are better but fan noise might be a problem if you're trying to record quiet sounds. There's a growing number of audio interfaces for iOS devices, which means easy portability and no fan noise. Some also work as USB interfaces with PCs and Macs. We haven't tried many of these so it's best to speak to a specialist retailer such as Digital Village ([www.dv247.com](http://www.dv247.com)) for specific recommendations.

Foley artists typically use a shotgun microphone, so called because it's highly sensitive in one direction and rejects sounds coming from other directions. The Sennheiser MKH 416 is the go-to microphone for professionals, but there are cheaper

alternatives if you don't have £700 to spend. The Audio Technica AT 875R costs around £125 and produces excellent results.

The objective when recording is to get a full-bodied tone without any extraneous background noises – hence the use of shotgun microphones. Regardless of microphone type, the best way to reduce extraneous noises is to record close to the source. Get too close, though, and there's a risk of the volume changing too much as the source moves around. You may also find the microphone picks up gusts of air or gets struck. There's also something called proximity effect to contend with, whereby bass frequencies are accentuated at close range. The best way to avoid these problems is to monitor using closed-back headphones that cut out the sound in the room and let you monitor only the microphone signal. Start with the microphone about a metre away and try different positions to find the best tone. For very quiet sounds you'll need to get closer to avoid excessive background noise.



↑ Celery is the perfect substitute for breaking bones – shown here being recorded with an Olympus LS-5 recorder, and also with an Audio Technica AT 875R shotgun microphone plugged into an iRig Pro and iPad



↑ The sharp end of a hammer going into a melon produces a deliciously gory crunch and squelch that works for all manner of stabbing and bludgeoning effects



If you're recording to a device other than to your video-editing software's timeline, consider how you'll get the recording in sync when you import it. It might be easy to do this by ear and eye, but you may want to put a short tone on the video soundtrack to use as a cue. Render the timeline to a video file with no audio except for a cue at the beginning, and use a tablet or Smart TV to watch it back as you record the Foley track. If you have a number of different scenes to record, make sure you label them clearly. The easiest way to do this is to write down a list of takes and introduce each one verbally at the start of the recording. Time spent labelling the takes could save hours sifting through dozens of recordings later.

### LARGER THAN LIFE

Coming up with inventive ways to make sound effects for sci-fi and horror films is undoubtedly lots of fun. However, much of the Foley artist's work involves re-creating the sound of footsteps, clothing, doors and other more mundane objects. These sounds are barely noticed by the viewer, but soundtracks will seem strangely lifeless without them. It's not just about filling a void, though. A thoughtfully created Foley soundtrack can really add to the narrative and emotive content of a scene. It gives the audience extra clues about the environment shown on the screen, helps to tell the story and might even elicit an emotional response in the viewer.

Foley soundtracks are often larger than life, with an exaggerated performance that's more physical than what's shown on screen. There is a point where it goes too far and becomes distractingly fake, but audiences are conditioned to accept these over-the-top sound effects. You can reduce their volume later to make them sit unobtrusively in the mix.

For footsteps, a Foley studio will have a wide variety of floor surfaces from tiles to floorboards to gravel, plus a collection of shoes to wear. If you don't have the right surfaces and shoes available, it's time to improvise. It's worth adding footsteps even when the character's feet are out of shot. The steps should be synchronised to when the shoulders are at their lowest point. If there's a crowd scene, giving footsteps only

## BRING THE NOISE: The Foley artist's box of tricks

Foley sound effects are often created with surprisingly mundane objects. Here are a few tried and tested techniques, plus a few famous examples:

■ Grass and foliage are often created by crinkling quarter-inch tape. You could do the same by pulling the tape out of a cassette.

■ Coriander also makes a good substitute for grass.

■ Large birds' wings are created using soft leather gloves or a combination of ballet shoes and feather dusters.

■ Dogs' feet are often gardeners' gloves with drawing pins on the fingertips. A real dog's collar will also be used in rhythm with the footsteps.

■ Celery is used for the sound of breaking and crushing bones, while rhubarb works better for popping joints.

■ For rattling guns, try door handles, spanners or tin openers.

■ Horror gore noises are often made with nothing more than washing-up liquid on hands, and perhaps a bit of watermelon abuse thrown in for good measure.

■ Punches are created by hitting large joints of meat. For a heavier body blow, try a croquet ball in a sock hitting a hollowed out pumpkin.

■ The *Star Wars* lightsaber noise was created from the hum of an old movie projector along with interference in the microphone from a television set. The swoops in pitch were created by playing the recording through a loudspeaker and re-recording it with a moving microphone to produce the Doppler effect – the same effect that's witnessed when a police car drives past.

■ In *Seven* during Gwyneth Paltrow's scene with Morgan Freeman in a diner, the Foley artist added the sound of her wedding ring hitting the mug to give a subtle reminder at a key time that she's married to Brad Pitt.

■ Bruce Willis in *Die Hard* was barefoot for most of the film so the Foley artist had to perform barefoot on several surfaces. Footsteps on glass were done with hands wearing gloves.

■ When Hugh Grant and Julia Roberts kiss in *Notting Hill*, the sound was supplied by a Foley artist kissing his own arm.



Use an old cassette to create foliage sounds

and believable. The fact that the sounds are actually less accurate than having no sound effect at all is beside the point.

The same principle applies in various other situations. When someone starts speaking into a microphone to address a crowd, Foley artists often add a short whine of feedback. This has become a sonic shorthand to show the character is nervous about speaking to the crowd. Feedback is very easy to create: simply play the microphone signal through

anything much at all, as scabbards are generally made of wood. That doesn't wash in Hollywood, though. A scrape and a ping is shorthand for sharp and dangerous, and that's what audiences expect.

Guns rattle as they're being carried in films. If a gun rattled in real life it probably means it's broken as the various parts shouldn't be jostling around. The rattle is there to draw attention to the gun rather than for realism.

Even in the relative calm of a documentary or business video, the sound of a handshake is often added by the Foley artist. Everyone knows that a firm handshake is the measure of a person's moral fibre, so finding the right gentle clapping sound can say a lot about the people on the screen.

## Even in the relative calm of a business video, the sound of a handshake is often added by the Foley artist

to one person will help them stand out. You'll need an ambient background noise for the rest of the crowd too, of course.

Clothing is surprisingly noisy in big-budget film and TV productions. Creaking leather can make a warrior seem even more butch, and the swish of silk makes the heroine more elegant, but any and all types of cloth can make a noise. These sounds make the world shown onscreen seem more richly textured

speakers and gradually increase the volume. Just be careful not to break your speakers.

The sound of swords coming out of scabbards are a complete myth. In Hollywood there's a searing noise of metal grinding against metal followed by a resonant ping. These sounds can be created by dragging two metal objects across each other, followed by the ping from a wine glass. Pulling a sword out of a real scabbard doesn't sound like

### TAKING STOCK

There are various sounds that are impractical to record in post-production: explosions, crashes, gunfire, car tyre screeches, sirens and animal noises are just a few examples. Fortunately there's no shortage of sound effect libraries available online: [www.sounddogs.com](http://www.sounddogs.com) is a superb resource with a library of 700,000 recordings produced to professional standards and with prices from

around \$2 to \$10. If that's still too expensive, head to the iTunes Store where sound effect libraries cost around £8 per album and 79p per track. There are various free sound libraries online too, although the quality is inevitably more variable.

Sound effects libraries can also be useful for doors closing, doorbells, kettles and so on – sounds that it wouldn't be particularly hard to record yourself but that might be easier to buy off the shelf for 79p.

Libraries are particularly useful for background ambiances. No environment is silent, and there are masses of ambient recordings available on Sounddogs.com, the iTunes Store and elsewhere. You'll find railway stations from around the world, car interiors, summer meadows, rainfall, birdsong and every conceivable type of battlefield from medieval times to the present day and beyond.

It's also worth recording about a minute of ambient sound while filming. It's impossible to record dialogue without capturing some ambient sound, but if you later decide to replace some sections of the original soundtrack, you'll need a recording of the background ambience to maintain continuity. You may even find that these ambient sounds

down simply by slowing it down, as this maintains the best possible quality.

If you're using a Sony editor, right-click an audio clip and select Properties. Under Time stretch / pitch shift method, select Classic and tick Lock to stretch. Click OK and, back on the timeline, Ctrl-drag the ends of the clip to shorten (and pitch up) or lengthen (and pitch down) the recording.

## Synchronisation to picture can be tricky to gauge, but as a rule if something looks and sounds right then it is right

set the perfect mood for the scene, in which case you might want to increase their volume.

### IN THE MIX

All that remains is to slot everything together in your video-editing software. If you've recorded your Foley tracks with a video camera you don't need the accompanying video footage, so find your editor's Unlink command and delete the video track, leaving only the audio.

Some sound effects will be more effective pitched up or down. Larger objects are generally deeper-pitched, so shifting an explosion down will make it sound bigger. You can always mix in the same explosion at the original pitch to maintain plenty of high-frequency detail too.

Some video-editing software supports this, although be wary of the ones that adjust the pitch without changing the length. That might be handy for synchronisation, but this kind of pitch-shift technique will have an adverse effect on sound quality. If the sound is a one-off event such as a door closing or an explosion, it's better to pitch it

Synchronisation to picture can be tricky to gauge, but as a rule if something looks and sounds right then it is right. To be sure, watch the video frame by frame and align sounds visually on the timeline. There's a fairly large margin of error in 25fps video with each frame lasting for 40ms. If you're not sure, it's best to place sounds late rather than early.

Setting volumes is possibly the hardest part of the process. Think of dialogue as the reference volume to which people will adjust the playback volume. In most cases dialogue is at or near full volume, but you may want to bring it down a little so explosions and other dramatic effects can have more impact when they go off at full volume. However, set the dialogue too low and full-volume effects will be annoyingly loud for viewers.


Footsteps, cloth and other effects that aren't intended to be particularly noticeable can be pretty quiet and still be effective. Remember that you can also pan sounds left and right in the mix, particularly as characters appear or disappear to the sides of the frame.

If footsteps seem too intense, try reducing the high frequencies with EQ controls.

Removing both high and low frequencies to leave a band of middle frequencies makes sounds seem more distant, which can be useful for providing some separation between foreground and ambient sounds.

It's also worth experimenting with reverb. This effect simulates the complex pattern of echoes that exists in every indoor environment, and to a lesser extent outdoors. Sound is generally recorded with as little natural reverb as possible in order to keep creative control to the mixing stage. This is the time to put it back in. Applying the same reverb to all the sounds in a scene will help give the impression that they all exist in the same space.

The type of reverb tells you about the size and shape of a space, what the walls are made of and whether or not the space is full of people or furniture. Luckily most reverb effects have plenty of presets with descriptive names so you can find something that matches the environment shown onscreen. Sound sources that are further away will have more reverb, so this is another way to place sounds further back on the virtual stage.

As usual for this column, we've only scratched the surface of a vast creative process that some people make a career out of. We hope we've inspired you, if not for a new career, then at least to pop down to the supermarket vegetable aisle to see how you can spice up your video productions. We guarantee you'll have fun trying. 



The screenshot shows the Sounddogs.com website interface. At the top, there's a navigation bar with links like 'ABOUT SOUNDDOGS', 'FAQ & SUPPORT', 'PRODUCTION MUSIC', 'SOUND EFFECTS', 'SITE DEMO', and 'CONTACT SOUNDDOGS'. Below this is a search bar with the text 'church door slam' entered. The search results are displayed in a table with columns for 'Select', 'Library', 'Preview', 'Description', 'Seconds', and 'Max Cost'. The results list various sound effects related to church doors, such as 'Crowds Church Latvia', 'Foley: Churches: Doors: Church Door: Interior, Slams, bolts lock door', and 'Door Open, Close / Squeaks, Various: Giant, Echoey Door Slam'. Each result includes a preview icon, a description, the duration in seconds, and the price.

↑ Sounddogs.com is a superb online resource for high-quality sound effects, and particularly for background ambiances that may be hard to capture yourself

### NEXT MONTH

#### TOP TIPS FOR SUPERIOR SNAPS

You don't need fancy equipment to take photos that are worth hanging on the wall. We reveal the tricks photographers use to get that perfect shot



# Applying dramatic colour correction

Perform radical colour shifts to photos with the help of your Android or iOS device. **Ben Pitt** shows how it's done



**FOR A COUPLE OF** days in February 2015 the world was gripped with one question: was it white and gold or black and blue? Somehow a snapshot of a dress had divided the planet and thrown everyone into a state of confusion (see [tinyurl.com/whatcolouredress](http://tinyurl.com/whatcolouredress)). One thing was clear, though: colour is a lot more subjective than we give it credit for.

The confusion stems from the fact that the colours we see are the result of two things: the colours of the objects themselves and the colour of the light bouncing off them. Illuminate a white wall with a household light bulb and it will reflect the yellow light from the bulb. Bathe it in sunlight and it takes on more of a blue tint. Most of the time we can process this information mentally, accounting for the light source and realising the wall is white. The same thing happens when a camera adjusts its white balance setting – or when you set the white balance manually.

The reason why that dress confused so many people was because it looked like it was photographed in shadow with a strong – presumably sunny – backlight. That would explain why the white parts have a slightly blue tint, due to the cold colour temperature of the sunlight. In fact, the dress was actually blue and black, and was photographed near an artificial light that brightened and warmed its colours, so black became gold and blue looked – almost – white.

When editing photos you can use this subjectivity to your advantage. Applying dramatic colour shifts can change the mood of the photo but still keep the subject looking



↑ Applying different tone curves to the red, green and blue channels results in different colour casts for the brighter and darker parts of the image (shown here using Photo Editor for Android)

colours, drawing the viewer's attention towards or away from certain details.

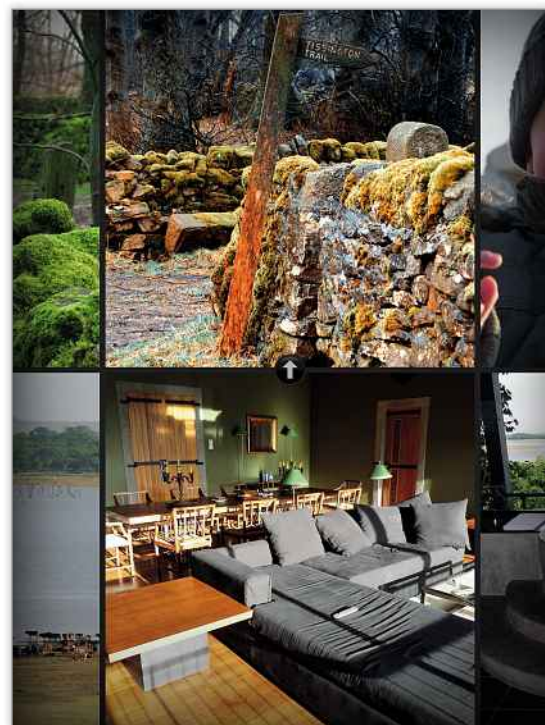
These techniques are often used in the retro filters popularised by Instagram but now included in a huge range of apps and built into many cameras. Some mimic different types of light source, while others seek to emulate the way film reacts in complex ways to different colours. As a rule, colour film was designed to

## Applying dramatic colour shifts can change the mood of the photo but still keep the subject looking recognisable

recognisable. Warmer or cooler colour shifts have an obvious association, with warm colours giving a feeling of cosiness or romanticism and colder colours feeling more austere. Boosting other hues can be just as evocative, with red for danger or sexuality, green for lush fertility, pink for romance or femininity and so on. These colour shifts need to work in conjunction with the colours in the image, of course. Boosting a particular hue may highlight or suppress existing

capture colours as accurately as possible, but limitations in film production and development processes meant that highlights might have a certain tint and shadows have a different one. This became a sought-after effect, where people would deliberately develop film using the wrong chemicals to skew colours – a technique known as cross processing.

Photos left out in the sun will fade over time, but it's common for certain colours to fade faster than others. The reason why an



↑ Color Thief for iOS clones the colours from one photo on to another, and transforming the green moss in the top photo into rich orange hues

old photograph ends up looking green, for example, is because the magenta ink has faded faster than the cyan and yellow.

### WARP SPEED

Readers of this column don't need any help using preset filters from the likes of Instagram, but there are other apps that allow more creative control. If you own an iOS device, check out Color Thief by Yellow Cedar Software (£149, [tinyurl.com/colorthiefapp](http://tinyurl.com/colorthiefapp)). It takes the colour palette from one photo and applies it to another. Simply select a pair of photos from the device's Camera Roll to see the effect. You can take colours from other people's photos by saving them from the web to the Camera Roll first. In Safari, tap and hold an image and select Save Image. Selecting pairs of images in the app is a simple matter of swiping left and right. Tapping an image and then the magnifying glass icon lets you browse to a particular image or folder.

The results vary from subtle to dramatic to downright bizarre. There's some elaborate



Playing with colour curves in Photogene for iOS has let us bring out the yellow in the dried earth and the blue of the sky



processing involved to match the brightness and hue in one image to those of another, but it's much easier to see the results in action than to read a long explanation. Skin tones can take a bit of a battering but part of the appeal of this app is how pairs of images can work quite unexpectedly.

## AHEAD OF THE CURVE

For full manual control you need an app with curves-based colour correction and separate control over the red, green and blue colour channels. There are a handful of apps that offer this, but sadly our favourite one – Photoshop Touch – has been removed from the Android and iOS app stores. If you have it installed we'd recommend using it to follow this tutorial, but for everyone else we'll call on some other apps.

For Android we recommend an app called Photo Editor ([tinyurl.com/332photoeditor](http://tinyurl.com/332photoeditor)). It's not the most glamorous-looking app but it's free and it has the tools we need. iOS users should go for Photogene 4 by Omer Shoor (£2.29, [tinyurl.com/photogene4](http://tinyurl.com/photogene4)), which is a superb all-rounder for image editing.

Launch one of these apps and import a photo. In Photo Editor, tap the Curves button. In Photogene, tap Adjustments, scroll down the control panel on the right and tap Show under the Curves heading. In both apps you'll see a diagonal line overlaid across the image. The shape of this line maps source colours on to output colours, so a straight line from the

bottom-left to the top-right means no adjustment. Dragging the middle of the line upwards brightens up the midtones. You can adjust brighter and darker areas in the same way. Photo Editor offers three control points with which to shape the curve, while Photogene lets you add up to four by tapping the line. On the whole it's best to use broad, sweeping shapes in the curve to avoid colours looking over-processed.

In this mode the Curves filter adjusts the brightness and contrast of the image. Tap the R, G and B buttons in Photo Editor, or the coloured tabs in Photogene, and you can create separate curves for each colour. For example, boost the red channel towards the bottom of the curve and shadows take on a red tint. Reduce the same control and shadows take on a turquoise tint as the blue and green channels dominate those areas.

It's easy to make a mess of colours using this approach. Small adjustments can have a big effect, and the three colour channels and the master curve all interact with each other in complex ways. However, if you're willing to leave photographic realism to one side there's plenty of scope for interesting results.

A big advantage of Photogene is that its colour-correction filters are non-destructive. That means you can jump between them to fine-tune settings without having to apply any to the image permanently. A colour curve might produce some interesting hues but the overall brightness and contrast needs some

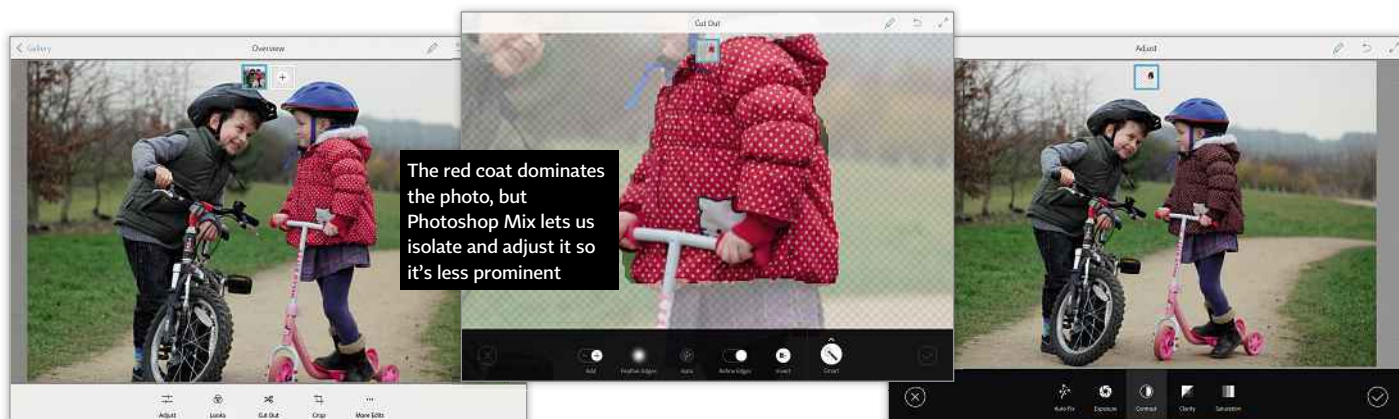
further adjustment. Scroll up Photogene's Adjustments panel and you'll find controls to give an overall boost or cut to the red, green and blue channels, white balance and saturation controls, exposure, contrast and the ability to lighten shadows and darken highlights. Layering up lots of heavy colour-correction processes can lead to surreal colours, but if that's the effect you're after then go ahead and pile them on.

Photo Editor is more restrictive as each process must be applied before another one is auditioned. Even so, there's a lot that can be done to further manipulate colours. The Levels filter is similar to Curves, except that it has simpler controls for the darkest, middle and lightest point in the brightness spectrum. Once again there's a global control, plus separate ones for red, green and blue. Meanwhile, the Color filter includes controls for brightness, contrast, saturation, temperature and tint, plus a hue control that rotates colours around the colour wheel.

## LARGER THAN LIFE

Sometimes a photo just needs a bit of help to make its colours and details really stand out. It's not a matter of adding creative colour casts but more about enhancing and amplifying what's already there.

Digital cameras are already adept at this, and their JPEG output invariably exhibits a boosted contrast compared to the most natural-looking results that are possible from



The red coat dominates the photo, but Photoshop Mix lets us isolate and adjust it so it's less prominent





cameras' Raw output. However, you can only boost the contrast so far before the highlights and shadows are reduced to blocks of solid white and black – an effect known as clipping.

There's another approach to creating punchier details that avoids this unwanted side-effect. It's sometimes known as local contrast, while Adobe and others call it Clarity. It's essentially a form of digital sharpening, whereby the differences in colour between nearby pixels are exaggerated. Behind the scenes this is done by comparing the original image with a blurred version; areas where there's a big difference between the sharp and blurred versions indicates there's fine or high-contrast detail. Digital sharpening works at individual pixel level to bring out the clarity of fine details. Local contrast works over a slightly larger scale to bring out tonal variations that might exist across a dozen or so pixels.

Once again it's easier to understand the effect by seeing it in action. Our favourite app for doing so is Snapseed by Google. It's available free for iOS ([tinyurl.com/snapseed](http://tinyurl.com/snapseed)) and Android ([tinyurl.com/snapseedand](http://tinyurl.com/snapseedand)).

Snapseed has three filters that use local contrast in different ways. The subtlest is Tonal Contrast, which has controls for High Tones, Mid Tones and Low Tones. Boosting these brings out details in those sections of the image, so you can add some punch to one part without affecting others. The Protect Shadows and Protect Highlights controls rein in dark and light areas to avoid clipping.

### DRAMA QUEEN

For a more dramatic effect, try Snapseed's Drama filter. This has six presets with different colour profiles, and each one has controls for saturation and overall strength of the filter. It suits some images more than others, but works particularly well for landscape shots where atmospheric haze can make everything look a little washed out.

The HDR Scape filter gives the most dramatic results, with colours and details that really leap out of the screen. It's designed to mimic high-dynamic-range (HDR) photography, whereby photos taken at

various exposure settings are combined into a single image. Snapseed works with only one photo at a time, but this filter shares the same souped-up colours and details. It tends to look too artificial for our tastes, but the People preset is subtler and the ability to adjust the overall strength, brightness and saturation provides plenty of scope for customisation.

Whether you choose Tonal Contrast, Drama or HDR Scape, you can always apply some further tweaks using the Tune Image tool. Keep an eye on the histogram display as you adjust. The curve should slope down to zero on the left and right. If the edges of the curve come to an abrupt stop that's a sign that you've clipped the shadows or highlights.

### SURGICAL EDITS

Sometimes colour correction requires a more targeted approach. All the processes described above are applied across the entire frame, but there are various ways to pick out specific elements in a photo for adjustment.

Snapseed's Selective tool is designed for just this. Tap the part of the image you want to adjust and pinch to adjust the radius of the affected area. The app only selects pixels in that area that are a similar colour, which is often highly effective at isolating a specific object in the frame without affecting other elements. You can then adjust the brightness, contrast and saturation for that area.

For even greater precision, try Adobe Photoshop Mix, which is free for iOS ([tinyurl.com/pmixios](http://tinyurl.com/pmixios)) and Android ([tinyurl.com/mixandroid](http://tinyurl.com/mixandroid)) devices. It can manipulate images on separate layers, and although it's less powerful than the discontinued Photoshop Touch, there's enough here to do the job.

In our photo (opposite) of the children with a bike and scooter, the girl's bright red coat dominates and draws the eye away from their faces. To combat this we've cut out the coat and placed it on a separate layer, which has then been colour-corrected independently of the rest of the scene.

Photoshop Mix is a bit funny in the way images are zoomed in and out. It's the usual pinch gesture, but when no editing tool is selected, pinching resizes and moves the

selected layer rather than zooming in on it.

The same photo must be imported twice for this task, but to avoid misalignment of the two copies it's important to avoid pinching the image when no editing tool is selected.

Open a photo and tap Cut Out. You can then zoom in for a closer view. Drag a finger across the part of the image you want to isolate and the app will try to make intelligent decisions about where the edge of that object lies. If it selects too much, tap the Add button to switch to Subtract mode. The Refine Edges function tidies up the edge of the selection to the best of its ability, and it's usually best to keep this enabled. These automatic results are rarely perfect, though. To tidy up the selection manually tap Smart and switch to Basic mode. You can then add or subtract pixels without the app trying to guess what you're aiming for. Tap the tick icon when you're done.

The app will then invite you to add a background image, so import the same photo again. Finally, select the upper layer with the isolated object, tap Adjust and use the colour-correction controls as necessary. These controls are relatively basic – you can adjust the brightness and saturation but not change blues to yellows, for example. If you want finer control over colours, consider editing a copy of the original image in a different app. The native iOS app includes a Colour Cast control to make colours warmer or cooler, and Photo Editor for Android includes a Hue control for completely transforming colours.

Virtually every photo will benefit from some subtle tweaks, but why stop there? We hope that this article has shown that dramatic results are only a few taps away, and can make the difference between a nice snap and something that really stands out. It's a lot more rewarding than slapping on a ready-made template, too.

### NEXT MONTH

#### CREATIVE KIDS

Kids glued to the tablet or phone? We reveal the apps that can engage their sense of creativity

# Zygote

Want to know how to destroy an entire industry in a matter of months? **Zygote** has the answer, with a little bit of help from Down Under

## KANGAROO CAUGHT

Ten years ago, Australia had a thriving video-games industry, with major companies such as Melbourne House, Ratbag and Krome churning out successful titles. As recently as a year ago, the Australian government was so enthusiastic about its games sector that it pumped A\$20m into a fund to jolly things along.

So it comes as a surprise to learn that the entire computer games industry has gone belly-up down under. Its last video-games house of any note, 2K Australia, has joined every other major Australian outfit, and been flushed down the electronic toilet of failure. This came as a surprise to the Australian Senate, as it launches an inquiry into what happened to the video-games industry in general and taxpayers' money in particular.

Perhaps Zygote can save them the time, cost and trouble of this investigation by pointing out that from 1994 to 2014, the Australian Classification Board banned an average of one game every three months on the grounds that it was unsuitable for human consumption. Since the beginning of this year, they have been banning an average of 40 games every single month. To rub salt into the gaping gaming wounds, the developers have had to stump up a thousand bucks in classification fees every time.

Zygote can't decide if it was the games companies or the Classification Board who developed collective madness, but the outcome has been the same either way. A total commercial disaster.

## ROBOCOUP

Zygote is concerned that the number of scam phone calls has increased by 30% over the past year. Zygote is further concerned that the number of fraudulent calls made by robotic diallers now stands at one in six, which makes it nigh on impossible to trace the scoundrels.

These calls are all designed to extract security details from gullible victims, and it seems there is no stopping this Rise of the Robots. After consulting with the electronic abacus, Zygote calculates that at the current rate of increase, by 2023 every single phone call will be a robotic scam.

## FREEDOM IS SLAVERY

Our Freedom of Information Act came into force on New Year's Day 2005. Three months before, Tony Blair's government installed a system that automatically deletes email records on Downing Street computers after a set period of time. And that set period just happens to be three months. Coincidence? Zygote doesn't think so. The Civil Service code of practice insists that 'important' emails must be saved, although Zygote has no idea who decides what's important and what isn't, let alone how anyone can check such decisions. An example of an 'important' email would be one that notes who attended a particular Downing Street meeting, what was discussed and what was decided, and it seems the archive of important emails is kept safe for posterity and future historians.

All well and good, but when it comes to anyone who wants to use the Freedom of Information Act to find something out right

now, we're restricted by a pre-set time and cost limit, which takes too long and costs too much to be viable. Nice one, Tony, how convenient. And nice one, Dave: the system is still in place today.

## NOT APPY

There are around 90 million Samsung Galaxy S4, S4 Mini, S5 and S6 smartphones knocking around. And evidence has come to light that all of them are wide open to hijack. One little problem is that the touchscreen app built into the software bundle updates itself automatically. One big problem is that updates are streamed over the web and downloaded via an unencrypted connection. One huge problem is that it's relatively simple to intercept the download and grab all the read-write permissions for any dodgy purpose at all. Oops.

## RED FACES

The UK Major Project Authority issues an annual report which rates every government IT project. Zygote reads this report once a year, so you don't have to. Projects are rated green, amber or red, and as you would expect, red projects are the ones that are flagged as high risk failures.

During the financial year 2014-2015, the report featured 188 projects, and Zygote finds 20 of the little darlings straying

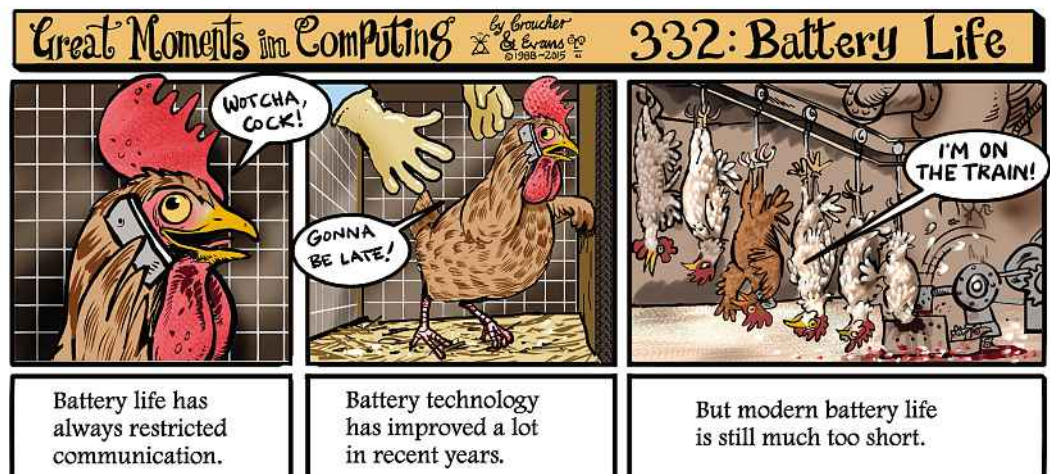
towards the rosy red end of the spectrum, where "successful delivery of the project is unachievable". The annual cost of these bummers? Two-and-a-half billion quid. Their lifetime cost? £35 billion.

Amusingly, the government can almost recoup the costs of these wee mishaps by cutting £30 billion in tax credits from the nation's poorest citizens. So that's all fine and dandy, then.

## ANT TWERP

Antwerp used to be a pleasant city for taking a leisurely stroll, until recently. Text addicts in this splendid Belgian metropolis recently woke to find they had been given their own pavement lanes, with delineated markings for walking and texting at the same time without crashing into non-electronic citizens.

A lot of stupid publicity has been generated in the media, so Zygote enquired what the Mayor of Antwerp thought about it. Not a lot, as it turns out. He has now declared that the text-only lanes break both city and federal laws, and should be criminalised as spray-paint graffiti. Those responsible will have to pay for the cost of removing the white lines and text-only markings, and they face a hefty fine on top. That'll teach them to walk on the wild side. ☹





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